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AN AMERICAN INSTANCE.

On other pages of this number, Mr. George F. Porter, gives a graphic account of the difficulties encountered and overcome by him and his fellow-workers in the successful laying of a cable in Norton Sound, Alaska, where the natural obstacles presented, together with a peculiar series of accidents, conspired to make the work probably the hardest that has ever been undertaken by a cable-laying expedition.

While no one can fail to feel some sympathy for the energetic men who were beset with such troubles in the conduct of their cable-laying operations, still it is pardonable to feel pride in the fact that the first American deep-sea cable was laid in almost record time, and in the face of apparently insurmountable difficulties, without assistance, and that it is now working and giving entire satisfaction. It is a little hard for those outside of the narrow field of telegraph and cable work to realize the full significance of the first attempt by an American manufacturer to build and lay a deep-sea cable. While much of the money, and no little part of the brains that backed the first transatlantic cable enterprise came from the United States, still the Atlantic cables were manufactured in England, and it is only of late years that any of the numerous important links of deep-sea cable that are to-day the nerves of the commercial world were made elsewhere than in Great Britain. While we, in this country, have led the advance in the majority of the electrical arts, still we have been far behind in the construction of these important adjuncts of civilization, and it is only within a year or two that we have been able to manufacture and successfully to put in place deep-sea cables of great length. When it is considered that much of our commercial prestige in the future depends upon the construction of a transpacific cable, and that strategy and military considerations render it absolutely necessary that this important line of communication shall be American throughout, it may be realized how important it is to develop amongst us the art of cable building and the far more difficult art of cable laying. While taking much from the experience of our cousins across the water we may still lay claim to a certain boldness of enterprise and swiftness of execution that has not marked their work in the past. An interesting story that Mr. Porter tells may perhaps illustrate the point we desire to make clear. Some two or three weeks after he had returned from his Alaskan experience, so vividly set forth elsewhere, he received a letter from a gentleman in England enclosed his credentials as a cable engineer (and it may be said that his credentials were excellent), and an application for an appointment in connection with the installation of the Cape Nome cable. It is peculiarly American that the cable was down and working (despite such trivial accidents as shipwrecks, Arctic seas, the end of the short Summer in those latitudes, and the utterly unspeakable rapacity of the pirates who masquerade as lightermen and tugboat captains in those parts) some six weeks before the application from England was received.

A NEGLECTED ART.

Next to astronomy electricity is certainly the most exact of sciences. Yet in its application to every-day affairs there is one of its branches, and by no means the least important, that is sadly behindhand in the matter of accurate measurements. We refer, of course, to photometry, or the art of measuring light. While we are enabled to-day to measure electric currents with the most extreme accuracy, and while the measurements of the power they are able to exert (either when this is taken as the energy of the circuit exhibited as electric flow or the output of motor apparatus exhibited as mechanical power) is highly accurate, when we turn electricity into light through the medium of the usual lamps we find ourselves embarrassed by the peculiar difficulties surrounding measurement of light and the very general misunderstanding both of the units employed and of the necessity for such measurements. Even to-day we find in current use such terms as "2000 candle-power arc light." As every electrical engineer knows, or ought to know, to-day this expression is absolutely meaningless. For every measurement of candle-power

we have a dozen different standards. Candle-power may mean horizontal candle-power, spherical candle-power, candle-power in a given direction, or a number of other things. Also, nobody knows exactly what a candle-power is. Of all sources of light perhaps the pine torch and the candle are the most variable. The standard candle is supposed to consume so many grains of its substance in an hour, but the light that it emits varies according to the plane in which it is looked at, and the condition of the wick, and of the atmosphere in which it is burning, and whether or not it is affected by drafts, until, upon the whole, the candle is an utterly and entirely unreliable measure of luminous intensity. The various standards of artificial light that have been made are almost equally unreliable because of the fact that no photometer fully takes into account differences in color as well as differences in luminous intensity of sources of light. The term "16 candle-power lamp" is therefore practically an anomaly, and the whole series of figures in which lamp efficiencies are expressed may as well be taken at random unless each is accompanied with an accurate specification of the way in which candle-power is measured and the variety of candle-power in which the measurements are expressed. If we could only get some measure of luminous output as simple and reliable as the yard-stick, for example, electric lighting would be placed upon a far better basis.

Meanwhile it should be the effort of lamp manufacturers and others interested in this important department of electrical application to decide upon some standard method of measurement, as well as some standard of luminous intensity against which such measurements may be compared. The whole subject is now in an entirely chaotic condition. Why should not the obsolete term "candle-power" be discarded in favor of something more rational and more nearly correct? The candle as an instrument of illumination has utterly disappeared in every civilized country, except as a sort of ornament for luxurious interiors. We do not know, or care, anything about the illuminating power of candles. When the new standardizing laboratory is established at Washington would it not be a worthy object of its first efforts to establish an absolute standard of light based upon some reasonable and invariable fact, and let this replace the loose and unsatisfactory term "candle-power?"

MUNICIPAL PLANTS.

One of the signs of the times is the establishment of numerous municipal electric lighting plants in the smaller cities of the United States. It takes some people a long time to learn anything. Certainly the experience of the various municipalities who have burned their fingers in experimenting with the hot chestnuts of the promoters should serve as a warning to those about to engage in the same interesting but dangerous game. Not once, so far as we know, in the history of the United States has a municipal electric lighting enterprise been a success. Careless or interested bookkeeping may make such installations appear successful for a short time, but somehow the administrative genius which is so well shown in other departments of public activity in this country seems to fall short when it becomes a question of managing a municipally owned and controlled electric light plant. If this were Utopia, and if our best citizens would serve as councilmen and committeemen for the management of such enterprises, and give to the public the talents by which they amass large fortunes privately, then perhaps municipal electric lighting schemes would pay. Until, however, we are awakened in our consciences to that point that the control of municipal affairs shall be taken away from the active politician and conferred as a high honor upon business men who can afford to take it, municipal ownership will always remain a dangerous and unsatisfactory experiment. Of course, the electric light man who has apparatus to sell does not hesitate to make a market where he can by convincing the city fathers of rural communities that they should undertake the electric light business. Beside, the electric light business is pretty and attractive and interesting, and men who would not for an instant think of conducting their own law business, or treating their own families in illness, or even patching their own clothes or furniture, will unhesitatingly tackle the management of an electric light plant with the public treasurer standing by to pay the bill. The failure of municipal ownership in this country is not due to peculation or mismanagement so much as it is to sheer ignorance and what may best be called bigheadedness. A man who knows that he could not walk into his neighbor's store and sell a pair of shoes or a yard of cloth successfully, will undertake, without hesitation, to sell kilowatts to a community when he has not even the most shadowy idea of what such things are, or what they cost to make, or how they are made, or how they are distributed, or what they are used for, or why, and this perhaps is the real reason why municipal ownership is at once so exceedingly attractive and so entirely dangerous to the rural community.

It is reported that the Snoqualmie Falls Power Company, of Seattle, Wash., has recently carried out successful experiments in the transmission of electric power to a distance of one hundred and fifty-three miles. All the transmission lines of the company were connected by a continuous line running from the station at Snoqualmie Falls to Seattle, thence back to the falls, then to Tacoma and back again to the falls. The regular transmissions undertaken by the company are thirty-two miles to Seattle and forty-four miles to Tacoma. While the tests were entirely for experimental purposes the results attained are such as to justify the belief that power transmissions for commercial purposes at this distance are practicable with the variety of apparatus employed by this company; that is, overhead lines working at moderate efficiencies and with reasonably high potentials can be trusted to transmit power to this very great distance. To put it in another way; the transmission radius from Niagara Falls, assuming that a similar potential could be worked conveniently from that point, would include Watertown, Utica and Binghamton, in New York; Pittsburgh, in Pennsylvania; Cleveland and Mansfield, in Ohio; Detroit and other cities in Michigan, and would take in a tremendous population easily able to absorb all the power that could be generated at that site.

Science Brevities

A Distortion Announcer—An interesting and ingenious little piece of apparatus is described in some of our foreign contemporaries. It is intended to give notice if the armature of a dynamo, through the wear of the bearings, is settling down toward the lower pole-pieces and is in danger of striking them to the destruction of the machine. It consists simply of a small brush set so that if the armature comes down a small distance—less than the width of the air gap—some part of the running mechanism will strike this brush and close an electrical contact through a battery and bell. In this way it is claimed that an occasional bad accident may easily and cheaply be avoided.

Contact Electro-motive Force of Mercury—Nernst's theory leads to the conclusion that two normal solutions of sodium chloride and potassium chloride respectively, should show the same difference of potential in contact with mercury or mercury powdered over with calomel. An *Electrician* note says: M. Rotté has verified this equality in a very direct manner by means of a capillary electrometer in which he employed the two solutions mentioned. He determined the electro-motive force at various capillary forces, and found the electro-motive force corresponding to a maximum capillary force graphically from the curve. For common salt the maximum electro-motive force was found to be 0.56 volt. For potassium chloride it was found to be 0.562 volt. This is a striking verification of Nernst's theory, especially considering that the same figures were obtained with the apparatus when sulphuric acid was filled in and withdrawn after each determination.

Testing Thermo-couples The Reichsanstalt method of testing thermo-couples intended for pyrometric work is described by Herren S. Lindeck and R. Rothe in the *Zeitscrift für Instrumentenkunde.* The chief innovation in the testing arrangement is an electric oven, consisting of four concentric porcelain tubes, only the outermost of which is glazed and covered with asbestos, says one of Mr. Fournier d'Albe's abstracts. The inner tubes are made of a very refractory material devised by Hecht. For temperatures up to 1,400 degrees the second tube is wound with a two-millimetre pure nickel wire, prevented from rusting by covering it with fireclay paste. For still higher temperatures the wire employed for heating is a platinum-iridium wire, by means of which a temperature as high as 1,600 degrees can be attained. When that temperature is exceeded the wire fuses into the porcelain. The temperature can be regulated with great rapidity and precision, the fine regulation being made by means of a sliding contact on a constantan band. The power consumed is 60 watts at 200 degrees and 1,540 watts at 1,300 degrees. A number of couples are tested simultaneously by means of a compensation method, the junctions being fastened by friction into a small circular gapped piece of platino-iridium. The errors of the measurements do not exceed 0.1 per cent.

Electric Traces on Photograph Plates—It will be remembered that a few months ago M. Leduc succeeded in producing on a small scale the phenomena of globe lightning. His method was to use electrodes consisting of needle points bearing upon the sensitive film of a photographic plate, when a slow discharge resembling a bright ball of light appeared to disconnect itself from one of the electrodes and zigzag itself over to the other when the points were connected with the poles of an influence machine. This interesting field of research has recently been thoroughly worked over by M. V. Schaffers, who obtained a large number of phenomena according to the arrangement of the electrodes, the current strength and the material of the film. When films are used containing mercuric chloride suspended in gum, or silver bromide in gelatine, tracings representing lines of force are obtained. With silver chloride in gum or silver bromide in starch zones of various degrees of activity arranged along equipotential lines are exhibited. Gold iodide gives beautiful diagrams of lines of force. The extraordinary phenomenon, however, of the moving ball is the most brilliant appearance noticed. The bright spot, or ball, leaves the negative electrode, and, moving along a path apparently of least resistance, and having no reference to the lines of force, proceeds slowly toward the positive electrode, reducing the salt as it goes along. It is suggested that this appearance is a simple cathode phenomenon produced at the head of a track of the reduced salt which forms a prolongation of the cathode.

Solar Repulsion—In Maxwell's theory of light a slight pressure caused by the impact of ether waves is postulated. As long ago as the time of Kepler it was endeavored to explain the extraordinary phenomena of comets' tails by an assumption that the radiation from the sun exercised a repulsive force upon these bodies. While a general acceptance of the undulatory theory of light has caused this suggestion to be lost sight of, it has recently been revived by Herr S. Arrhenius, who enters into some calculations in a German contemporary concerning the amount of this pressure. In the immediate neighborhood of the sun he calculates that a body of unit specific gravity and of cubic form, one centimetre on each edge, would lose about one ten-thousandth part of its weight owing to the radiation. If the size of the particle is diminished the loss becomes comparatively greater, since the volume decreases more rapidly than the surface under such conditions. Thus the weight of a cube of 0.0001 centimetre on a side would be exactly balanced by the repulsion due to radiation, while a particle of half that diameter would be given a velocity of repulsion such that it would describe a path equal to the sun's diameter in one hour. Applying this suggestion, the author elaborates an interesting and apparently convincing theory of the formation of comets' tails, the curvature of which he explains by the variations of the radiation with the distance of the component particles from the sun and to the size of the particles repelled. If these are of molecular dimensions their repulsion would be of the order already observed, which presupposes a repulsive force from 10 to 100 times as great as the attractive force of gravity.

Telephone Connection for Fast Passenger Trains.

To the Editor of Electrical Review:

I note your editorial suggestion of a telephone exchange on express trains. May I suggest an extension of the service to include the means for connecting the train with the telephone exchanges in important cities where stops are made, thus giving the passengers local and long-distance service during such stops.

It often occurs that passengers on long journeys are desirous of communicating with parties who would thus readily be within reach and if the telephone exchanges in the larger cities will provide means of connection with such trains, a very great convenience to travelers will result. One of the large steamship lines has recently installed such service, connecting its vessels at the wharf with long-distance service, to the great satisfaction of its patrons, and it occurs to me that the same service could readily be applied to the more important passenger trains.

E. K. Sumerwell.

New York, November 28.

THE THEORY OF ALTERNATING DYNAMO-ELECTRIC MECHANISMS—VI.

BY W. ELWELL GOLDSBOROUGH.

An alternating electro-motive force that energizes circuits containing resistance and inductance may therefore be considered to be the resultant of two component electro-motive forces, one (e_r) that lags behind it and overcomes the resistance of the circuit and the other (e_l) that is in advance of it and overcomes the electro-motive force of inductance. But the current (i) is always in phase with (e_r), therefore, *in circuits containing resistance and inductance the impressed electro-motive force and the current are not in phase; the current lags behind the impressed electro-motive force.*

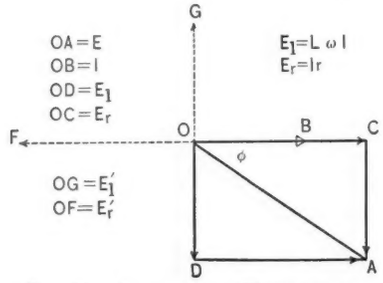


FIG. 20.—ALTERNATING MECHANISMS.

In Fig. 20, let OB = I, the maximum value attained by the current, then (OC), which is in phase with I and equals

$$I_r = E_r,$$

is the maximum value of that component of (E) (the maximum value of the impressed electro-motive force) which forces the current through the resistance of the circuit. The electro-motive force of self-induction lags 90° behind (I) and is represented by $OG = e'_{l\,max.} = E'_l$, therefore (OD), which is equal and opposite to (OG), equals the electro-motive force required to overcome the electro-motive force of inductance, equals $e_{l\,max.} = E_l$, and since (OG) is lagging 90° behind (OB), (E_l) is 90° in advance of the current (I).

The resultant of (OC) and (OD) will be OA = E, the maximum value of the impressed electro-motive force,—

$$e = E \sin \omega t,$$

and as indicated by the figure,—

$$E = \sqrt{E_r^2 + E_l^2}. \qquad (46)$$

The angle AOC = ϕ, is the angle of lag of the current behind the impressed electro-motive force, and as the current is a sine function its value at any instant is expressed by the equation,—

$$i = I \sin (\omega t - \phi), \qquad (47)$$

therefore

$$d i = I \omega \cos (\omega t - \phi)\, d t \qquad (48)$$

and as it has been shown (see page 569, equation 43) that $d \Phi = L\, d i$, therefore

$$d \Phi = L \omega I \cos (\omega t - \phi)\, d t \qquad (49)$$

and since

$$\frac{d \Phi}{d t} = - e_i' = e_l \quad \text{by} \quad (44)$$

we have finally that

$$e_l = L\ \omega I \cos (\omega t - \phi) \qquad (50)$$

$$= L\ \omega I \sin (\omega t - \phi + 90°). \qquad (51)$$

Equation (51) shows that (E_l) is 90° in advance of the current, and that its value may be expressed in terms of the inductance of the coil, the angular velocity and the maximum value of the current, since when

$$\sin (\omega t - \phi + 90°) = 1,$$

(e_l) will have attained its maximum value (E_l),

$$e_{l\,max.} = E_l = L\ \omega\ I. \qquad (52)$$

The value of (I) can be expressed in terms of (E) and the dimensions of the circuit, for since in Fig. 20 OC = RI and CA = L ω I, therefore

$$E = I \sqrt{r^2 + L^2 \omega^2} \qquad (53)$$

and

$$I = \frac{E}{\sqrt{r^2 + L^2 \omega^2}}. \qquad (54)$$

The value of the angle of lag of the current depends directly upon the dimensions of the circuit, since the tangent of the angle AOC = L ω I ÷ r I = L ω ÷ r, therefore

$$\phi = \tan^{-1} \frac{L \omega}{r}. \qquad (55)$$

Combining equations (47), (54) and (55) we can finally obtain a more general expression for the current, since by the substitution of (54) and (55) in (47) we get,—

$$i = \frac{E}{\sqrt{r^2 + L^2 \omega^2}} \sin \left(\omega t - \tan^{-1} \frac{L \omega}{r}\right). \qquad (56)$$

This is the form commonly given to the equation expressing the instantaneous value of the current. It can be derived by the direct integration of the fundamental equation of the electro-motive forces acting in a circuit containing resistance and self-induction, which is generally expressed in the form,—

$$e = r i + L \frac{d i}{d t} \qquad (57)$$

and is but another form of equation (38), ($r i$) being equal to the electro-motive force necessary to overcome the ohmic resistance, and $L \frac{d i}{d t}$ equal to the electro-motive force of self-induction.

(For the direct integration of (57) see: Bedell and Crehore's Alternating Current, chap. iii, page 48, or Fleming's Alternating-Current Transformer, vol. i, chap. iii, page 105.)

Equation (56) shows that the effect of inductance in a circuit is not only to cause the current to lag behind the impressed electro-motive force but also to decrease its value, for, when L = 0, (56) reduces to,—

$$i = \frac{E}{r} \sin \omega t \qquad (57)$$

which is a direct result of Ohm's law, and what we would expect with an impressed electro-motive force of the form,—

$$e = E \sin \omega t.$$

In this case the current is in phase with the impressed electro-motive force, and its maximum value (see 54) increases to,—

$$I = \frac{E}{r}. \qquad (58)$$

On the other hand, when $r = 0$, (56) reduces to,—

$$i = \frac{E}{L \omega} \sin (\omega t - 90°) \qquad (59)$$

showing that when the inductance of a circuit is high relatively to its ohmic resistance, its ohmic resistance can be neglected and the current will lag 90° behind the impressed electro-motive force, while its maximum value will equal,—

$$I = \frac{E}{L \omega}. \qquad (60)$$

If we examine the radical in (53) and (56) we see it is the square root of the sum of two squares. We can, therefore, represent it as the hypothenuse of a right angled triangle *Oac*, in Fig. 21, if we lay off the base $Oc = r$ and the side $ca = L \omega$. By comparing Figs. 20 and 21 the angles AOC and *aOc* are seen to be equal, since the tangent of each equals L ω ÷ r. In fact Fig. 21 can be obtained from Fig. 20 by dividing each of its sides by (I) the maximum value of the current. Fig. 21 is therefore the triangle of resistances corresponding to the electro-motive force triangle of Fig. 20. The radical

$$\sqrt{r^2 + L^2 \omega^2} = z,$$

is called the "effective resistance" or the impedance of the circuit, and its value is expressed in ohms. R is the ohmic resistance of the circuit. And L ω is called the "inductive resistance" or the reactance of the circuit; its value is also expressed in ohms, and it is denoted by the letter (x). Therefore

$$z = \sqrt{r^2 + x^2}.$$

The "coefficient of self-induction" (L) of a coil (see page 569) is, as stated above, also called the "inductance of a circuit" or simply the inductance. The value of the inductance of a circuit is expressed in henrys.

The Chamber of Delegates of the Chicago International Electrical Congress of 1893 adopted: "As the unit of induction, the henry, which is the induction in the circuit when the electro-motive force induced is one international volt, while the inducing current varies at the rate of one international ampere per second." If, therefore, the uniform increase in the current flowing through a coil of *one ampere per second* will maintain a difference of potential at the terminals of the coil of *one volt*, then the coil will have an inductance of *one henry*.

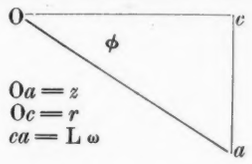


FIG. 21.

In other words, a coil has an inductance of one henry when, for the coil, the expression,—

$$\left(\frac{4\pi \times n^2 \times A}{10^9 \times l}\right) = 1,$$

and the permeability of its core is unity. Example No. 4.

Given:—A circuit containing an air core transformer with an open secondary circuit; maximum electro-motive force of the alternator 75 volts; resistance of line nine ohms; resistance of primary six ohms, and inductance of primary .3 henry. $n = 132$, and the impressed electro-motive force is a sine function.

What is the maximum value of the current flowing in the circuit? What is the value of the angle of lag of the current? What is the equation of the instantaneous current? What is the impedance, or the effective resistance, of the circuit?

By equation (54) the maximum value of the current equals,—

$$I = \frac{75}{\sqrt{(9+6)^2 + (.3\,\omega)^2}} = .3009 \text{ ampere,}$$

since

$L\,\omega = 248.8$ ohms, and is the reactance of the circuit,

$L^2\,\omega^2 = 61908.0$

$r = 15.0$ ohms

$r^2 = 225.0$

and

$$z = \sqrt{225 + 61908} = 249.2 \text{ ohms,}$$

and is the impedance of the circuit.

Again, from equation (55),—

$$\pi = \tan^{-1}\frac{L\,\omega}{r}, \text{ therefore } \cos\phi = \frac{r}{\sqrt{r^2 + L^2\,\omega^2}} \qquad (62)$$

and, from (34), since the radical $= E \div I$,

$$\cos\phi = \frac{I\,r}{E} \quad \text{[see also Fig. 20]}$$

therefore, $\phi = 86°\ 33'$, or $= (86°\ 33') \div (57°\ 18') = 1.51$ radian, since a radian equals $57°\ 17'\ 44.8''$, nearly.

Combining the above results,—

$i = .3009 \sin (829.4\,t - 1.51)$, from (56).

It is noticeable that z is but little greater than $L\,\omega$ and that the current lags nearly 90° behind the impressed electro-motive force.

A New Use for X-rays.

One of the gentlemen connected with the state archives in Rome, Italy, Signor Briguiti, announces that the Rœntgen rays have been successfully used for copying manuscripts concealed beneath book covers when the ink of the manuscript contains red lead, cinnabar, or ultra-marine blue.

Continuing with his researches the expert says that in certain cases the rays may be used to successfully detect forgeries and concludes his remarks by saying: "I have used the rays both in connection with alleged Old Masters and wills thought to be forged—in both cases without material result. In the case of the Old Masters, I tried to find if there were any signatures. Old pictures are varnished periodically to preserve them, and the signatures are often obliterated, or rather covered up. I found no signatures. It is doubtful, however, whether the rays would have revealed them, supposing them there, unless they were very thickly painted. As to wills, the rays might detect if the parchment had been made thinner by erasure; but the microscope would probably show this still better. The visibility of a substance to the eye is no criterion of its visibility to the X-rays. The rays can not see through glass, which is transparent to the eye, whereas aluminum, which is opaque to the eye, is transparent to the rays. The rays can see a splinter of glass in the hand, but not a splinter of wood. Most inks are transparent to the X-rays, including printer's ink, but some are opaque. The rays can see through a post-office directory, but if a paper with words written on it in opaque ink is put in the middle of the directory the rays will reveal those words, and nothing behind them." It would appear, therefore, that the rays can only detect, say, a forgery in a check, providing the body of the check is written in transparent ink and the forger is considerate enough to make his alteration in opaque ink, or *vice versa*.

This report is unconfirmed, but seems to be within the range of practical possibilities.

EARTHQUAKE AT CARACAS, VENEZUELA.

BY E. H. LUDFORD.

The very severe earthquake at Caracas on October 29, proved conclusively that the elasticity of aerial electric conductors enables them to withstand shocks far better than more rigid constructions.

Houses fell in all directions, and there is scarcely a building in all Caracas without some damage to its walls or roofs; nearly all the public edifices, government buildings and churches have suffered greatly, most of them being considered unsafe; the railways had slips on their lines, interrupting traffic to a greater or less extent; but not a single pole carrying electric conductors was thrown down by the direct effect of the shock.

The telephone company had hundreds of lines crossed from the severe rocking, and a few iron poles bent from houses falling against them, but its whole plant consisting of about 2,000 lines otherwise remained intact.

"La Electricidad," a company which has utilized the falls at El Encantado for developing power which is transmitted to Caracas, a distance of 16½ kilometres by triphase current for running motors, had its lines thrown together in several parts, thus burning out the fuses at the station, but its overhead construction was not damaged in the slightest.

The electric light company had lines broken down in different parts of the city by falling roofs, but none of its lines or poles was otherwise damaged.

The Brazilian Exposition of Next Year.

Reports from Petropolis, Brazil, state that early next year an exposition will be held at Belle Horizonte, the capital of Minas Geraes, under the auspices of the Brazilian Government. American manufacturers are invited to exhibit electrical, mining, agricultural and other mechanical appliances, and it is stated that the expense connected with such exhibits will be comparatively small, while the facilities and opportunities for making a good show and obtaining profitable business will be considerable. Any firms that are desirous of obtaining further details regarding the matter may communicate on the subject with the United States Consulate General in Rio de Janeiro.

Cable quotations have been requested from Havre, France, for more than $16,000 worth of trolley line materials, according to recent reports.

CABLE LAYING IN ARCTIC WATERS.

THE STORY OF THE LAYING OF THE ST. MICHAEL-CAPE NOME CABLE AND THE WRECK OF THE CABLE-SHIP ORIZABA.

BY GEORGE F. PORTER.

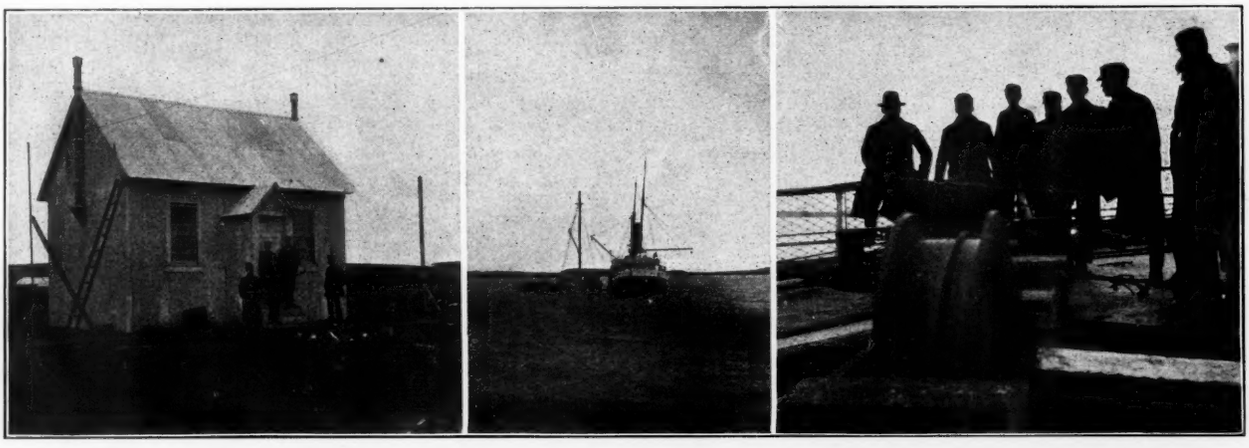
A good deal has been written about the laying of the first Alaskan cable last Summer, and concerning the accident which befell the cable-ship Orizaba. It may be interesting at this time to give a short account of what really did happen and thereby possibly clear up some misunderstandings that have existed regarding this piece of work.

The order, which was given by the United States Government, contemplated the making, laying and equipping of 187 miles of cable, divided into two sections. A deep indentation, known as Norton Sound, enters the western coast of Alaska from Behring Sea, the north shore of the Sound being the peninsula terminating in Cape Prince of Wales, which is the nearest point of the American mainland to the Asiatic coast. At the bottom of Norton Sound—that is, at its extreme eastern point—lies the village of Unalaklik. At the western extremity of the northern shore of Norton Sound, where the coast again trends northwardly, is Cape Nome, the famous northern Eldorado, while southwest from Unalaklik, on a small island close to the southern mainland of Norton Sound, is the town of St. Michael. The cable was to be laid in two sections, one of which 55 miles long connected Unalaklik with St. Michael, while the other, 132 miles long, crossed the Sound from St. Michael to Safety Harbor at Cape Nome. These cables were to connect at Unalaklik with the land telegraph line running from that point up the valley of the Yukon River through the various gold mining camps and thus connecting with the general land line system of the continent. It is interesting to note in passing that this land line is being constructed under peculiar difficulties. There is no timber in the country through which it passes, hence iron poles are used and it is expected that this Winter's snows, furnishing as they do good sleighing facilities, will permit the completion of the line. While the surface of the country is largely covered with the tundra or spongy moss, it is only necessary to dig a little way to find the eternal ice and a pole is soon set and firmly held in position by pouring a little water into the hole around it which freezes and will remain frozen forever unless disturbed in some way.

For the purpose of laying the cable the steamship Orizaba, of the Pacific Coast Steamship Company's service was chartered, this ship being of steel about 1,000 tons registry and a rather broad beam and light draught craft excellently suitable for the purpose. The cable itself was manufactured at Seymour, Ct., by the house of W. R. Brixey, the Kerite compound being used for its insulation, and was shipped by rail in large coils on open freight cars to San Francisco where it was jointed as it was fed into the hold of the Orizaba. The cable was made with a conducting core of seven No. 24 B. & S. gauge tinned copper wires, insulated with a cover of pure rubber one sixty-fourth inch thick. Over this is laid Kerite up to a diameter of eight-thirty-seconds inch and then a layer of tape. Over the tape layer is built up a serving of three-ply tarred jute to an outside diameter sufficient to receive the armor of 16 No. 12 B. & S. galvanized steel wires. The armor is fully protected with two reversed layers of three-ply tarred jute.

The cable arrived duly at San Francisco and arrangements for its reception were made in the forward and after holes of the Orizaba by pulling out the stanchions and setting them again between decks so as to form an approximately circular cage 24 feet in diameter under each hatch. One hundred and thirty miles of the cable were coiled in the forward hold, making a coil 24 feet in diameter and eight feet deep, while 57 miles of it were stowed away in the after hold. Through this 57 miles we discovered that telephone conversation was easily possible. We left San Francisco in the face of a strong northerly breeze that combatted our passage until we arrived in the Behring Sea when the wind shifted and the twelfth day out found us feeling our way slowly through a heavy fog, which, when it lifted, revealed the sandy beach of Nome City. A curious incident happened at this point. We met the steamer Roanoke, which was leaving Nome and on which was Major-General A. W. Greeley, Chief Signal Officer United States Army, who had expected to meet us there several days earlier but who had given us up and was returning to Washington. A boat was sent to the Roanoke and General Greeley was taken aboard the Orizaba, and was with us through the subsequent troubles and difficulties.

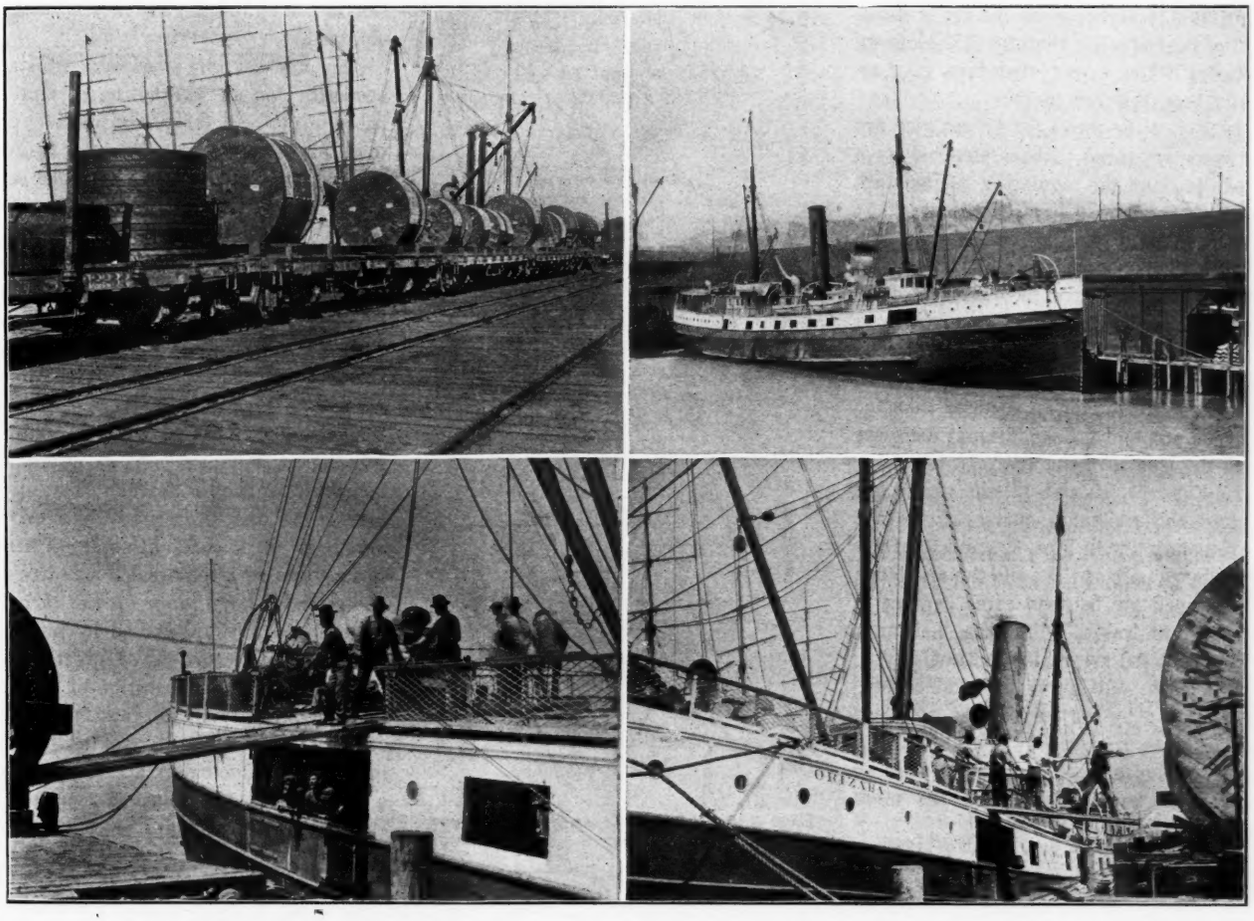
It was resolved to run over to St. Michael and start the laying of the cable from that end toward Nome. The day that we commenced operations was a fair, calm day and we hastened to seize what might possibly be the only opportunity to lay the cable during the Summer, for in those waters the weather is most uncertain and practically all that can be said about



THE CABLE HUT AT ST. MICHAEL. TAKING CABLE OFF THE WRECK. PAYING OUT CABLE AT THE START.

CABLE LAYING IN ARCTIC WATERS UNDER GREAT DIFFICULTIES.

it is that one is sure to have weather of some sort every 24 hours. The United States Government's steam launch took one of the government lighters and landed the instruments and supplies intended for the station at St. Michael; the shore end of the cable was then loaded in one of the ship's boats and towed ashore by another. The end was then made fast at a point where it connected with the short land line to the cable hut and the boats returned and were on the davits within an hour and twenty minutes. Everything being ready we started at a four and a half knot gait, going slowly out around the end of Whale Island and finally heading northwestwardly toward Nome; everybody was feeling happy and comfortable, the cable was running beautifully over the sheaves and the men in the tank below seemed to be handling the bights as they came up with perfect ease. Indeed we were getting ready to crowd on an extra knot or so of speed when all at once, without warning and while we were still in sight of shore, there came the unmistakable grinding and crunching that told us the Orizaba had encountered a reef. I wish to state at this point that the statement made concerning this reef not being on the government charts is a mistake; the charts showed, as we afterward verified by taking exact measurements of the position of the grounded vessel, only 13 feet of water at that point and we were drawing 13½. The ship rested easily but it did not take more than a hasty examination to show that she was badly damaged. The question then was to save the cable and if it was humanly possible to lay it anyhow. A lighter was secured and a small ocean going paddle-wheel steamboat to tow it and the cable was pulled out of the hold and coiled on the lighter's deck, the weather, for a marvel, holding good all the time. The lighter was rigged up with a small jockey block on the end of a beam from its short mast and through this the cable was passed. Luckily we had enough cable, for the combination of paddle-wheel steamboat and lighter steered somewhat irregularly and the cable now lies at the bottom of Norton Sound in a sinuous line far different from the straight course that it would have had had the ill-fated Orizaba not perished on the reef. However, the cable is laid and is now in operation. The work being finished we had to take what transportation we could get and our party finally secured quarters aboard a tramp steamship, at that time doing a thriving passenger business between Alaska and American points. The journey back in that ship was something good to look back upon as an experience, but bitterly disagreeable while it lasted. Provisions were very short and a strange vessel had to be stopped in the solitudes of the Pacific Ocean to supply us with food. The water on board the ship, if boiled and mixed with vinegar, could be drunk by a man if he was very thirsty. Among the other supplies that we received from the friendly vessel that came to our assistance was a case of Apollinaris water, for which the demand was so strong that it retailed at $6 a quart bottle. We found out, however, that when it rained, as it frequently did, we could hold, three of us, a rubber coat with the sleeves turned wrong side outwards, one man holding the lower end of the sleeve and thus painfully gather a sleeveful of water; this we bottled in the empty Apollinaris bottles, and in this manner managed to slake our thirst somewhat until we reached Seattle. We were comforted, though, even in this unpleasant passage by the knowledge that we arrived at Seattle with the Cape Nome cable in good working order despite the continued series of accidents that threatened to prevent its installation.



THE CABLE ON THE CARS AT SAN FRANCISCO.
COILING CABLE IN AFTER HOLD.

THE ORIZABA.
SENDING THE CABLE ABOARD THE STEAMER.

GETTING READY TO LAY THE CAPE NOME-ST. MICHAEL-UNALAKLIK CABLE.

THE ALTERNATING-CURRENT ARC.—II.

BY C. WILER.

In Fig. 5 a non-inductive resistance has been put in place of the arc; in series therewith is an inductive resistance of 4.77-ohm impedance.

Figs. 6, 7 and 8 show the wave forms for an arc of the same length steadied by an inductive resistance; Fig. 6, for solid carbons; Fig. 7, for solid and cored, and Fig. 8, for two cored carbons. The power factor of the arc between solid carbons is considerably higher when the arc is steadied by the inductive than by the ohmic resistance. The cause, therefore, has already been referred to.

In Fig. 9 the waves for an enclosed arc between two cored carbons steadied by a choke coil and the regulating magnets are shown. Current 6.4; arc voltage 70.5; power factor .915.

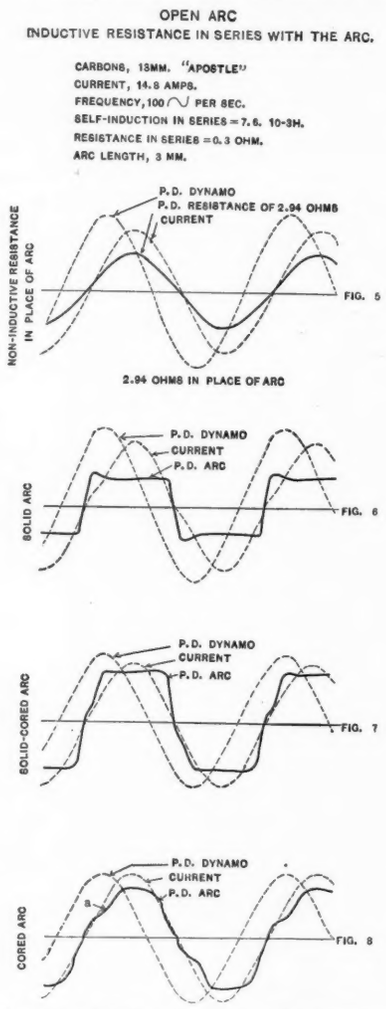
In Fig. 10 the enclosing globe has been removed and the waves have been recorded for the same arc length and current as in Fig. 6. The power factor has increased to .945. The distortion of the waves is, therefore, greater for an enclosed than for an open arc, and for the latter it increases with the length of the arc.

In Figs. 11, 12 and 13, the writer has plotted the resistance curves of the arc corresponding with Figs. 8, 9 and 10. During a large part of the cycle the resistance of the open arc between cored carbons is of constant value, while the resistance of the enclosed arc varies continuously.

It is now well established and conclusively shown by the curves that no phase difference is produced by the alternating arc, either open or enclosed, with solid or with cored carbons, although the mere quotient $\frac{\text{watts}}{\text{current}} \times \text{voltage}$ would indicate it. This calculation, however, is only correct for sine waves. Current in the arc and arc voltage can not be sine waves simultaneously, as shown in the foregoing.

The curves in Fig. 9 of the enclosed arc are the only ones ever obtained on an alternator with small armature self-induction, with which the writer is familiar. A further investigation of the enclosed arc by the oscillographic method would be of great interest and perhaps of considerable value. The power factor of an enclosed arc changes with the carbons, it increases with the size of enclosing globe and decreases with the area of the opening left around the carbon in the gas cap. The reasons are self-evident from the foregoing. The more rapid consumption of the carbons by alternating-current enclosed arcs, when the arc descends in the inner globe, may also be attributed to the increasing power factor, as it seems that under these conditions the influx of air into the inner globe is facilitated.

A comparison of the resistance curves of the enclosed arc and of the open arc would lead one to expect that the open alternating-current arc was the steadier and more peaceful of the two. The open alternating-current arc, however, requires for its successful application for commercial lighting, high-grade carbons and different sizes for changes in current. These two points were, with the decreased luminous efficiency of the open alternating-current arc, the humming, the rapid consumption of the carbons, the sensitiveness to atmospheric conditions responsible for the many failures in alternating arc lighting with open arcs. The enclosed alternating-current arc can not very well be used commercially above 7.5 amperes, and one size of carbon is, therefore, sufficient for all conditions. The use of high-grade carbons has become universal with the increase in life on account of the use of enclosing globes, and the humming is practically eliminated and a better distribution of the light and greater steadiness are obtained.



FIGS. 5 to 8.—THE ALTERNATING-CURRENT ARC.

The amount of steadying resistance necessary for an alternating-current arc is, as explained above, considerably less than for a direct-current arc. Recently the Western Electric Company has advocated the use of alternating-current arc lamps in series on constant-potential circuits with 72 volts at the arc, 6.6 to 7 amperes, and only 78 to 80 volts terminal pressure at a frequency of 60 cycles, and with no other regulating device during normal operation than is contained in the lamp. A large number of installations, comprising circuits of 3 to 50 Western Electric Company's series alternating lamps, have shown that alternating arc lamps operated in series direct on the mains or on a constant-potential transformer possess a remarkable stability and an extremely large range for the variation in terminal pressure caused by inductive loads. This feature is of great importance for successful operation of alternating arc lamps on light and power circuits. The present practice of connecting alternating-current arc lamps singly on circuits of 104 volts, as required for the incandescent lamps, meets the demand for small installations. The power factor of these lamps is very low (about 65 to 70 per cent), mainly due to the abnormal reduction of the line voltage to the arc voltage. The power factor of the series lamp, on the contrary, is, with a reduction from 78 to 80 volts to 72, very high, averaging about 85 per cent. This great advantage should lead central station men to the consideration of operating alternating

Fig.	Carbons. Top.	Carbons. Bottom.	Resistance in Series Ohms.	S. I. in Series. Henrys.	Impedance of Inductance Coil. Ohms.	P. D. Arc. Volts.	Power Arc. Watts.	Power Factor. Arc.	Notes
5	2.94 Ohms in Place of Arc.		0.3	7 6 10^{-3}	4.77	43.4	642	1.00	To be Compared with Fig. 6.
6	Solid.	Solid.	0.3	7.6 "	4.94	50 2	635	0.855	Slightly Hissing.
7	"	Cored.	0.3	7.6 "	4.79	37.8	536	0.96	Not Hissing.
8	Cored.	"	0.3	7.6 "	4.80	31.6	461	0.985	"

arc lamps in series on the mains, or, if insulation of the arc circuits is necessary, they can be connected on constant-potential transformers in groups of three, on 220 to 240 volts, seven lamps on 500 to 550 volts, or 13 on 1,000 to 1,050 volts, and so on to as large units as desired.

The alternating arc, which gave so much promise in the early decades of the century, has reached at its end a high degree of perfection, so that in its new form it has once more taken up the competition with its former rival, the direct-current arc.

BICHROMATE BATTERIES.

BY ALFRED G. DELL.

In the following I propose to give my experience in the use of bichromate of potash batteries when used for induction coils. The two things that are of great importance in the use of such batteries are the prevention of polarization and obtaining a low resistance in the cells. The latter is obtained by putting the zincs close to the carbons, and having good connections.

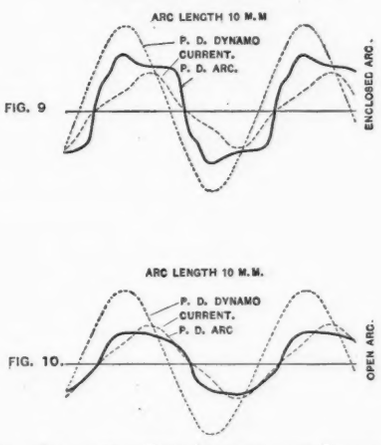
As to the prevention of polarization, it is more difficult. When the solution is new, of course, if the bichromate is well dissolved there will be but little, if any, polarization, but after several days, with moderate use, if the solution becomes cold, polarization will set in when the cells are in use for only a few minutes; 70 degrees or below seems to be fatal to the solution in a short time. No excess of solution will prevent it. With a temperature of 90 degrees or above, the solution will act well for some time, possibly three weeks or more, depending upon the use of it and its quantity.

The trouble is to prevent the bichromate from forming crystals at the bottom of the cells.

There are two ways of making the solution: First; mixing the bichromate with hot water, stirring it frequently, and then, when cool, adding the sulphuric acid. Second; mixing the water and sulphuric acid, and then adding the bichromate. The first will do well, but I always prefer the second, if I have hot sunshine in which to set it. In this case it is well to stir it frequently with a stick when quite warm from the sun. The bichromate will mix in the shape of flakes and when it sets a little longer in the sunshine the flakes will dissolve, making a prime solution. Such a solution, if the temperature is not below 80 degrees Fahrenheit, will last a considerable time, depending, of course, upon use, providing the carbons are all right. When the cells then begin to polarize, they can again be brought back by setting it in the sun and stirring the solution again, always having some of the bichromate crystals in the bottom of the cells. The second time it will not last anything like as long as the first. The carbons and zincs should always be washed off and let dry while the solution is being prepared.

COMPARISON OF ENCLOSED AND OPEN ARC AT CONSTANT ARC LENGTH. CHOKE AND REGULATING COILS IN SERIES WITH THE ARC.

CARBONS, 13 MM. "SIEMENS," BOTH CORED. FREQUENCY, ~ PER SEC.



FIGS. 9 AND 10.—THE ALTERNATING-CURRENT ARC.

Fig.	P. D. Alternator Terminals. Volts.	Carbons. Both.	Arc Length. M.M.	Current. Amps.	P. D. Between Terminals of Arc. Volts.	Power Arc. Watts.	Power Factor. Arc.
9	100	Cored "Siemens" in Davy Enclosed.	10	8.4	70.5	542	0.915
10	82.5	Cored "Siemens" in Hand Lamp.	10	8.5	42.2	338	0.945

There is no trouble with the acid; it is all with the bichromate.

One important part is the carbons. Some cells will polarize sooner than others. I have traced this trouble to the connections between the carbons and the metals. I have frequently examined the carbons where connected, by removing them, and have found the connections were made almost invariably through small bolts passing through the carbons and metals, the carbons and bolts appearing to be cemented together with carbon, as if the carbon had been condensed around the bolts. Likely it is a current effect. The metals against which the carbons rest, flat surfaces, appearing generally to make no connections, I renewed some by insulating all about the connections, excepting the bolts, by covering the carbons and the metals with a mixture of ivory black and shellac, excepting where the bolts passed through, which I kept clean, and as an additional insulation, I placed between the carbons and metals, where covered with the mixture, pieces of mica, and then, after putting together, I painted the whole with the mixture of ivory black and shellac, extending it down the carbons about an inch. The mixture excludes all the battery solution from the connections, but, of course, does not prevent it passing up through the carbons. It does not get too soft in the cells, but acts as well as could be desired.

I have found many carbons, when they have been in the solution awhile, have a tendency to crack or split at the connections, the cracks extending down the carbons, and at first appearing on the outside, and, if not stopped, extending through in the course of a little time. This cracking the insulation mentioned above seems to have entirely prevented.

One favorable condition about the above-described Poggendorff variety of battery is that the zincs can be raised out of the solution and then there is no action, excepting the bichromate forming crystals on the bottom of the cell, which, in favorable temperatures, is very slow.

With the Bunsen battery, one important condition is to have proper porous cups. If they are too hard, but little current will pass through, and if too soft the bichromate and acid solution will pass too freely through to the solution containing the zincs, and, in the course of a short time, the bichromate solution, with the carbons, will become too weak and that passing to the solution containing the zincs will attack them.

The trouble with this battery is, that, although, while new, it will excite an induction coil to perfection and furnish a large current in the primary if the cells are of a fairly large size, for several hours, the bichromate is all the time coming through the porous cups, although these may be suitable, and there is no way of which I am aware to stop this action except to renew the solution in them. Crystals left in the cups do not seem to do well. I worked with Bunsen cells some time ago for several years. I had to renew the porous-cup solution once a week and the entire solution every month or my battery would be worthless. I had also frequently to amalgamate the zincs, while with the other battery, the zincs being small, their amalgamation is a small matter, also the renewal of the solution easy. Of course, where a cell is warranted to furnish a large current for several hours, the Bunsen is the proper cell.

Automobiles

A report from Brussels states that Baron De Crawhez, of the Automobile Club of Belgium, starts on a motor trip through Biskra and the Sahara about December 1. The mean touring radius of his machine, which is a 12-horse-power vehicle, is about 300 miles.

One of the largest orders received by an automobile manufacturer came recently from a New York daily which has ordered 30 electric vehicles for its circulation and delivery department, intending to supersede the horse entirely with the new conveyances.

The Motor Club of France has recently changed its headquarters to 4, Rue Meyerbeer, Paris. During the coming year the club will place sign boards to mark the location of caniveaux, or the paved water courses which cross the roads at places where they are least expected and make high speeds dangerous.

The Automobile Club of America held a run on November 17 from the Waldorf-Astoria, New York city, to the Casino at Ardsley, where luncheon was served, after which the participants continued on over the Boston post road and thence back to New York. Several speedy brushes gave the run something of the appearance of a big road race.

A 14-year boy is the latest person to receive a license from the Chicago, Ill., commission for licensing automobile operators. A woman of that city who also passed the required examination is said to have announced her intention of becoming a teacher so that her own sex may have the benefit of her experience and learn how to handle their machines "like a man."

Heavy delivery wagons and carriages in Buenos Aires, Argentine Republic, are meeting with considerable success. The roads are rapidly being improved, a touring club has been organized to take care of the interests of automobilists and throughout the entire republic a movement is on foot to reserve special roads for motor cars, light electric vehicles and bicycles.

Many young women of Washington, D. C., in diplomatic circles, are expert chauffeuses, driving their own automobiles with considerable skill, handling them like veterans. Among the ladies thus prominent are Countess Cassini, niece of the Russian Ambassador; Madame Wilde, the Argentine Minister's wife; Mrs. Senator Hansborough, of North Dakota; Miss Martha Hichborn, Admiral Hichborn's daughter, and many others equally prominent.

During the Autumn tour of the Automobile Club of Great Britain, which was held in October, from the fifth to the ninth, the towns of Hounslow, Wallingford, Circenster and Monmouth were visited going out, while the return was made through Cheltenham and Oxford. The trip on the whole was very satisfactory and Birdlip Hill, which is considered the most dangerous in the Island, was successfully gotten over without any serious accidents, only one Peugeot voiturette being smashed.

The recent automobile expositions at Madison Square Garden and Grand Central Palace, New York city, have again brought to the attention of the public, and manufacturers in particular, the relative sizes of these two structures. It frequently has been asserted that the Grand Central Palace has not the amount of exhibition space that is available in the Garden, but this is an error which is made apparent by the following figures, supplied to the ELECTRICAL REVIEW from an authoritative source. The actual floor space in the amphitheatre at Madison Square Garden available for exhibits and aisles is 34,080 square feet. The actual floor space on the main floor of the Grand Central Palace available for the same purpose is 44,688 square feet. In addition to this the first balcony in the Grand Central Palace, which is also available for exhibits, affords 38,000 square feet more.

While attempting to dodge a heavy delivery van on one side and a loaded truck on the other a locomobile at the corner of Fifth avenue and Twenty-second street, New York city, came to grief in a surprising manner during the rush hours one morning a few days ago. The driver of the machine attempted to turn a corner at too high a speed, and as the asphalt was slippery from the rain of the night before, his machine capsized, throwing him out onto the muddy street. The machine itself lay on its side and moved crab fashion in a circle, making a curious slithering sound until some one who evidently understood the machinery stepped up and turned the power off, after which, with the assistance of passersby, it was righted and found to be uninjured save for mud and scratches. The unfortunate driver, however, had a ruined coat, the back of which presented the appearance of an elaborate plaid in dark brown-green and tan, a bruised nose and a plentiful stock of sulphurous adjectives to show for his adventure.

A novel feature of the Automobile Show at the Grand Central Palace, New York, was a pursuit race between a steam runabout and a gasoline machine, both the vehicles being driven by former professional bicyclists. Before the start there was some little difficulty in the men understanding how they were to begin the race as the character of the machines made a flying start necessary. At length the starter caught them exactly opposite each other in the centre of the track and gave the word to go. The race in itself was exciting on acount of the shortness of the track and the fact that it was not banked. Both machines were evenly matched and though the gasoline machine obtained the decision on the tenth lap, which was the limit for the race, the driver of the locomobile protested and a return race was arranged. After the race was finished an electric jaunting car, carrying besides its driver four passengers, essayed a waltz, turning and performing various fancy figures to the music of the band; though not always in time it was a pretty sight and was considered particularly fine, as it was entirely impromptu.

A list of dont's for those interested in automobiling appeared recently in a daily newspaper, some of them containing rather amusing suggestions, of which the following are fair samples:

Don't try to explain to a countryman how the steam gets into the wheels. They will either not understand, or think you are guying. In the first instance, you waste your breath, and in the other you are apt to get into trouble.

Don't disregard injunctions of policemen, but slow up—for the time being, at least. He may be able to telephone ahead to arrest you.

Don't, when in an electric vehicle, run up to the limit as shown by the volt and ampere register. You may find yourself stalled between stations and asking for a tow.

Don't lose your temper when you are roundly abused. The only good it can do is to get you in trouble in a strange place, where all the chances are that the other fellow will get the best of it.

Don't get the idea that you are the only thing on the road.

Don't, if you get stuck on a hill, forget to turn your machine and try to back up with the reversing gear. This, being a still lower gear, is more powerful.

Don't fail to be extra cautious when you meet a woman driving. She is usually more frightened than the horse.

Don't try to head off a trolley car because you have speed. Something might happen in the middle of the track to stop you.

Experiments on Hertzian Telegraphy with a Telephonic Receiver.*

M. Guarini has sent us an account of some experiments he has performed which constitute a verification of certain ideas of his published since June, 1899. They are described briefly below:

1. Using a telegraphic key, a current of about four amperes was sent from a battery of eight accumulators through the primary of an induction coil possessing a contact breaker. The secondary of the coil gave nearly two-inch sparks between a point and a plane; the resistance of the primary winding was 0.11 ohm, and of the secondary windings, 8,000 ohms. In the present experiment the secondary terminals were nickeled knobs, which charged a Righi oscillator with balls of about four-inch diameter and about one twenty-fifth inch apart. From one of the knobs, 8, Fig. 1, a single insulated copper wire about 12 metres long led to a telephone, 12, whose other wire, 13, remained hanging free. The telephone was thus in a perfectly open circuit. But when Morse signals were sent by the key, 1, they were received and interpreted easily by a listener at the telephone. M. Guarini concludes that Hertzian currents produce magnetization of the telephone core as well as ordinary currents; and that telegraphy on a single wire, without earth or other return, is possible by means of Hertzian waves and a telephone.

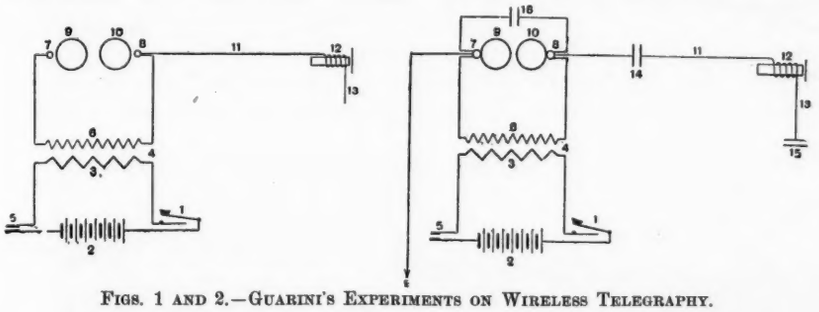
2. A condenser was interposed between the knob of the coil and the telephone. The signals were much improved. This leads M. Guarini, by analogy, to conclude that in ordinary wireless telegraphy the interposition of a condenser in the air-wire might improve the transmission of signals!

3. The condenser was attached to the free terminal of the telephone instead of being placed as in the last experiment (see Fig. 2). The noise in the telephone was again increased.

4. A combination of the second and third arrangements (*i. e.*, with two condensers) resulted in the production of still clearer and louder signals.

5. The condenser was in this case placed across the knobs, which had been placed in contact with the corresponding balls of the oscillator. The more this capacity was increased the louder became the sounds in the telephone.

6. The other knob of the induction coil was now put to earth, the second terminal of the telephone remaining free. The signals were loud, but not louder than before.



FIGS. 1 AND 2.—GUARINI'S EXPERIMENTS ON WIRELESS TELEGRAPHY.

7. The knob connected to the telephone was put to earth, the other knob of the coil being free. There was practically no noise then heard in the telephone, as might have been expected. M. Guarini concludes, however, that this experiment shows that most of the energy is radiated from the knob at which occurs the greatest variation of potential!

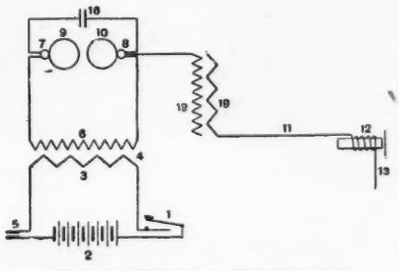


FIG. 3.—WIRELESS TELEGRAPHY.

8. The combination of the conditions in experiments 5 and 6 showed that the putting to earth of one knob of the coil is of comparatively little benefit when there is a condenser across the spark-gap of the coil.

9. By combining experiments 4, 5 and 6, and adjusting the condensers, a very powerful effect was obtained. For the first time the ear had to be protected by being insulated from the telephone. M. Guarini suggests that this demonstrates that the proper use of condensers in wireless telegraphy would lead to great increase in the possible distance of signaling. In experiments 10 and 11 (see Fig. 3) M. Guarini interrupts by a transformer the lead going to the telephone. He finds that the oscillations are very perfectly transformed. Next he repeated carefully the preceding experiments when all the sending apparatus was enclosed in a metal box, and found that signals were exactly as before.

Further, M. Guarini has performed a similar series of experiments when there was no conducting communication between the sender and receiver (see Fig. 4). He used horizontal "antennæ" or air-wires nearly 10 feet long and worked with a distance of several yards between them. At first the telephone terminal not connected to the receiving antennæ was free, but later was connected to one side of a condenser.

The condenser improved the signals. Afterwards, this condenser had its free terminal earthed while the free knob of the induction coil was also earthed; and from his observations M. Guarini deduces that, by this last mode of connecting, signals could easily be transmitted to distances between 10 miles and 20 miles by using antennæ of 180 feet to 200 feet in length. The chief advantages of this mode of receiving are, of course, its inexpensiveness and its convenience, and these, the author thinks, may enable the method to be of some utility in special cases.

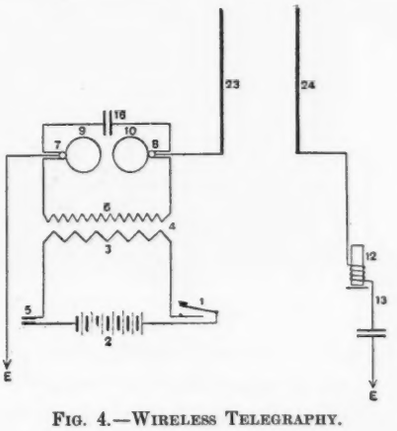


FIG. 4.—WIRELESS TELEGRAPHY.

Theses at the University of Illinois.

The following subjects for theses have been approved for the senior class in the electrical engineering course of the College of Engineering at the University of Illinois:

Investigation of the Wave Forms of Alternators and Synchronous Converters, Behavior of a Rotor in a Three-Phase Field, An Experimental Study of Phase Transformers, Behavior of a Rotor in a Two-Phase Field, Conditions Affecting the Rated Performance of Wattmeters, Line Regulation in Polyphase Transmission, Performance of a 10-Kilowatt Synchronous Converter.

A report from northern New York states that a mortgage for $125,000 has been recorded in the county clerk's office in Yates County, the Empire State Telephone and Telegraph Company being the mortgagor.

*From the *Electrician*.

THE PLANT OF THE ST. CROIX POWER COMPANY, OF WISCONSIN.*

BY HENRY FLOY.

INTRODUCTORY.

The considerable number of high-tension long-distance transmission plants already in successful operation, might not render the completion and starting of a 25,000-volt plant of any particular interest, except that in all engineering work and especially in electrical lines, the "newest" usually means something of a change from and improvement upon anything previously constructed.

There are, however, some features both hydraulic and electrical connected with the plant of the St. Croix Power Company, recently put into operation, which I think will prove of more than ordinary interest to the members of this Institute.

GENERAL DESCRIPTION.

About two years ago the St. Paul Gas Light Company, of St. Paul, Minn., owing to increasing business, the depreciation and antiquity of its generating apparatus and the expense of operating four distinct stations, foresaw that it must build a single modern and larger steam generating plant or arrange for securing current by means of long-distance transmission through the development of one or more of the water powers within reasonable distance of St. Paul.

Upon investigation it was found that 27 miles east of St. Paul, on Apple River, in the state of Wisconsin, there was a natural fall of about 30 feet. Above the fall a dam could be built to a height of 47 feet, thus affording with a slight drop in the river below the fall a total head of 82 feet. Apple River is fed from innumerable springs and some 25 lakes in northwestern Wisconsin, and in consequence its discharge is remarkably uniform the year around. With the head afforded the minimum flow of water in the stream would yield about 2,000 horse-power continuously and during most of the year nearly twice that amount. By the building of a dam, a large reservoir would be formed from which the impounded water could be drawn in any quantity necessary to carry the peak of any load in St. Paul, provided sufficient capacity was installed in water-wheels, generators and transmission line. It was thus demonstrated to the St. Paul Gas Light Company that the power that could be made available at Apple River Falls by a development of the character just outlined, would permit not only the complete shutting down of its four steam plants and avoid the necessity for building a modern steam plant but also provide it with nearly twice the saleable output of its old stations.

Accordingly, about a year and a half ago, there was organized under the laws of the state of Wisconsin the St. Croix Power Company. This company is friendly to the St. Paul Gas Light Company and to the latter the former contracted to sell all the current it could generate by the development of a power plant at Apple River Falls.

HYDRAULIC DEVELOPMENT.

The accompanying map, Fig. 2, shows the property purchased outright by the power company, and gives a very good idea of the location of the original falls and the present dam, flume and power-house. Above this property only the right to flow such land as would be inundated by the storage reservoir was acquired.

Owing to the inaccessible location of the dam, being about five miles from a railroad station, and the country very rough and hilly, the importation of building stone for the dam was out of the question. The only material available at the falls is a brown sandstone, somewhat harder than the St. Peter rock underlying much of St. Paul and Minneapolis, but not hard enough to withstand constant attrition of the water. It was, therefore, decided to build the dam with a masonry core, resting on concrete foundations and enclosed in concrete facings.

The masonry core was not carried higher than within six feet of the crest of the dam, and was built of uncoursed rubble masonry laid in Portland cement mortar, consisting of three parts of sand to one of cement. Both the sandstone and unlimited quantities of clean, sharp sand were found on the company's property.

The concrete, not only in the dam but

FIG. 1.—GENERAL VIEW OF THE ST. CROIX POWER COMPANY'S PROPERTY.

* A paper presented at the 148th meeting of the American Institute of Electrical Engineers, New York, November 23, 1900.

forebay, power-house and machinery foundations, was composed of one part by measure of Portland cement, three parts of sharp sand mixed with four parts of broken stone. The broken stone was obtained by crushing granite trap or gneiss boulders, commonly called "nigger heads," into cubes not larger than three and a half inches or smaller than one inch; the "nigger heads" being collected from neighboring farms.

Fig. 3 shows the cross-section of the dam through the spillway. It will be noted that the dam is carried down below the level of the bed rock in the centre of the stream to a depth of almost five feet, in one broad trench and that there are three other trenches about a foot deep running entirely across the bed of the stream. The banks of the river which rise 25 or 30 feet above the top of the dam are composed of solid sandstone. Into these the dam is carried some 25 feet on the north bank and 18 feet on the south bank. The main seepage trench along the bottom of the dam being carried up and well into both river banks to absolutely cut off any chance for seepage around the ends of the dam. All seepage trenches were filled and all exposed rock covered with concrete before any masonry was laid. The concrete facings on the up and down stream sides and top were, of course, tamped in between the masonry and wooden forms.

The dam is of the arched type, being built as the arc of a circle having a radius of 450 feet. Near the north bank, close to the bed of the river, two steel pipes, each five feet in diameter are built into the concrete work and fitted with gates and crabs to permit control of the water while constructing the dam, or in time of repair, and the regulation of flow over the spillway in case of unusually high water.

At the south end of the dam are the trash racks and near them a sluice for conveniently disposing of the debris and ice.

The length of the spillway is 108 feet, and the total length of the dam 350 feet. There are 3,138 cubic yards of concrete and 5,025 cubic yards of rubble masonry in the dam.

Incidentally, it may be mentioned that when carrying the north end of the dam into the sand rock, a spring was encountered. This was taken care of by laying a pipe for it to discharge through, then building the dam right up and around it.

There has been some controversy as to whether concrete dams are satisfactory, especially in northern latitudes, and the dam here described, although only partially of concrete, will add, I think, another argument in their favor.

It is a pleasure to state that although this dam has experienced extremes of temperature and stresses, it does not show any signs of cracks or leakage, and a number of engineers, experts on this class of work, who have seen the dam since its completion, unanimously agree that the concrete work is of the highest grade and that the dam as a whole is a most perfect monolith.

While it is too early to determine the ultimate success of this construction, satisfactory results thus far accomplished are due primarily, I believe, to the following:

First—All materials in the concrete were of the very best quality. Alsen and Atlas cements were used exclusively, and severe tests made continuously to insure no deterioration in the grade of cement.

Second—No concrete was laid and allowed to freeze before setting. The work was started early in September, a year ago, and the Autumn was most favorable for outdoor work, which was carried on without interruption until the middle of December, then closed down by cold weather. At that time the north end of the dam had been completed and the south half brought up to within about 18 feet of the top. It stood in this condition throughout the Winter and until April 5, when authority was given the contractor to proceed with the work.

Third—Although the dam was wholly complete about May 1, it was allowed to stand almost two months before the waste gates were shut and the water raised to the spillway. This allowed the concrete to thoroughly set and harden before any strains were put upon the dam.

Fourth—The work was done under constant competent and rigid supervision, with the result that the concrete was of a uniform consistency and mixture, and properly tamped in position.

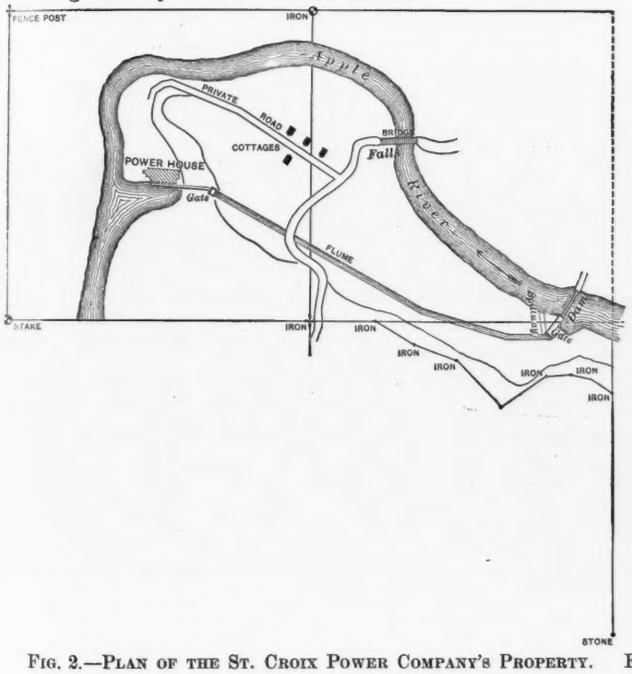


FIG. 2.—PLAN OF THE ST. CROIX POWER COMPANY'S PROPERTY.

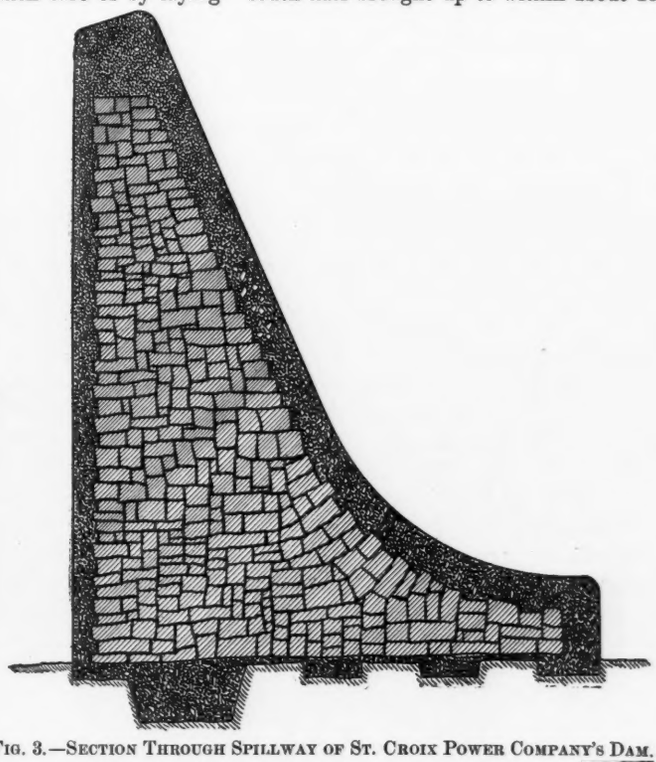


FIG. 3.—SECTION THROUGH SPILLWAY OF ST. CROIX POWER COMPANY'S DAM.

FLUME, FOREBAY AND PENSTOCK.

Although the river bed follows the course shown on the map, the sandstone cliff recedes from the river at a point just below the dam, leaving a less precipitous

sand embankment in which the flume has been built as far as the roadway. Beyond the roadway the embankment widens out into a plateau in which the flume is buried. The flume begins at the south end of the dam and with two slight angles runs 1,550 feet west, ending in a forebay at the point marked "gate" on the map. From this forebay a steel penstock, 12 feet in diameter, takes its beginning and is used to convey the water down an abrupt embankment to the power-house and tail race 82 feet below.

The flume is constructed entirely of wood, caulked with oakum and braced by both vertical and horizontal tie rods. The bottom stringers are of Oregon fir, which is a superior grade of pine, particularly free from knots and imperfections, found in Washington, Idaho and Oregon, and becoming very largely used in the northwest. The balance of the timber in the flume is Norway pine, except the tongues which are white pine. Fig. 3 shows the cross section of the flume as built, which is of the same dimensions throughout its length. The flume rests on excavated foundations, is level throughout its length, filled on both sides and covered to a depth of two feet with earth.

With a velocity not exceeding three feet per second, it was designed to convey 670 cubic feet of water per second, being sufficient to generate 5,000 horse-power, under an 82-foot head with wheels having an efficiency of 80 per cent.

The forebay at the lower end of the flume is located about 100 feet back from the brow of the hill. It consists of a rectangular steel box, 24 feet wide, 24 feet long, and 17 feet deep and is designed to connect the flume with, and serve as an anchorage for the penstock, and also to afford a place in which to locate gates and racks. The steel box is built of three-eighth inch steel, rigidly supported by I beams and braces. It rests on a concrete foundation and is supported on all sides by heavy masonry walls, 12 feet thick at the bottom. One of the end walls is pierced by the flume, and the other by the flared mouth of the penstock which is securely riveted to the box and flanged into the supporting wall. Just in front of the forebay and at right angles to and extending 10 feet below the bottom of the flume, is a concrete cutoff seepage wall, 42 feet long and three feet thick, designed to prevent the possibility of any water leaking through and following along the sides of the flume and attacking the forebay foundations.

At the head of the flume and close to the dam there is a lateral overflow or waste weir, connected with the side of the flume, and designed to prevent the water in same rising above a predetermined point and putting the top of the flume under pressure. This waste weir is about 27 feet in width and slopes from the side of the flume to the bank of the river. It is designed to automatically prevent any increase in the level of the water in the flume, regardless of how much the water in the reservoir may rise—within reasonable limits—above the spillway. The level of the upper end of the weir where it joins the flume is the same as that of the spillway, but by means of small gates the level of the overflow may be raised to the top of the flume if desired.

In the dam at the head of the flume are three head gates and the iron trash rack previously referred to, while at the lower end of the flume in the forebay are three tail gates with finer trash rack.

The penstock is 12 feet in diameter. It takes its beginning in the forebay and extends in a horizontal direction 88 feet to the brow of the hill, down which it continues 107 feet at an angle of about 45 degrees. Then it turns again and continues in a horizontal direction 118 feet further. The penstock is of open hearth steel plate, three-eighth inch thick above the elevation of 140.61 and seven-sixteenth inch below that elevation. The sheets of which the penstock is composed are held together by rivets, spaced two and one half inches on centres, all rivet holes being punched one-sixteenth inch small and reamed out to full size; all joints being caulked and the whole painted with an iron preservative paint. The penstock is supported throughout its length on suitable masonry piers. On the hillside, the earth has also been tamped under the pipe to give it additional support. The lower end of the penstock is provided with four branch pipes supplying four main sets of water-wheels, and a smaller fifth branch pipe ending in a "Y" supplies two separate exciter wheels. At the lower end of the stock is provided a gravity automatic relief valve having a discharge 12 inches in diameter. The last section of the penstock is provided with a blank opening for an additional and fifth unit in case it ever becomes desirable to install the same.

GENERATING STATION.

The generating station is a fireproof structure of brick and iron, about 140 feet by 50 feet, divided longitudinally by a partition wall, thus separating the wheel-room from the dynamo-room (see Fig. 8).

In the wheel-room are four main sets of water-wheels, space being reserved for the fifth unit which may be added later. Each set consists of two 36-inch special "Victor" wheels, mounted horizontally in a nine-foot cylindrical steel wheel-chest from which they discharge through a six-foot draft tube, eight feet long. Each pair of wheels is, of course, on a single shaft which extends through the end of the wheel-chest built into the partition wall, and is direct-connected to a 750-kilowatt generator. Each wheel-chest is supplied from the penstock by its own feeder pipe in which is located a 56-inch gate valve operated from a shaft driven by a seven and one-half horse-power electric motor. Each wheel-chest is surmounted by an automatic spring-relief valve having an opening 12 inches in diameter. There are two exciter wheels, each direct-connected to a 30-kilowatt direct-current generator. The exciter wheels have their own branch feeder pipes, wheel-chests and separate gate valves.

The water-wheel governors are of an improved type of the Geissler pattern. They are guaranteed to maintain the speed within three per cent of normal for any instantaneous change in load not exceeding 25 per cent of the load at the moment of variation. The governors are electrically controlled, being operated by the 125-volt exciter current.

All the alternators are 750-kilowatt, three-phase, 800-volt, 60-cycle revolving armature, separately excited machines, running at 300 revolutions per minute. They will carry full load continuously without heating more than 40 degrees centigrade above the temperature of the surrounding air, and have an inherent regulation slightly under five per cent on non-inductive load.

The direct-current exciters are shunt wound, operating at 925 revolutions per minute, and each machine is of sufficient capacity to excite five 750-kilowatt alternators.

Across the lower end of the dynamo-room is the marble switchboard consisting of an exciter panel, four generator panels, two transformer panels, and a local service panel. The exciter panel is supplied with the usual instruments but the alternator panels are each equipped with one main oil switch, in series with two triple-pole, quick-break jaw switches, for throwing the machine on to either of two sets of bus-bars. At the top of the panel is an ammeter, an indicating wattmeter, and a field ammeter with the usual synchronizing lamp, field-switch and voltmeter plug. The transformer panels will each be provided with an induction recording wattmeter, a single three-phase oil switch of

special design, having a capacity of 1,500 kilowatts at 800 volts, and a potential indicator which enables operators at the generating station switchboard to determine the voltage at the St. Paul substation, regardless of the power factor of the load or the drop in the line.

A brief description of this type of potential indicator may not be amiss.

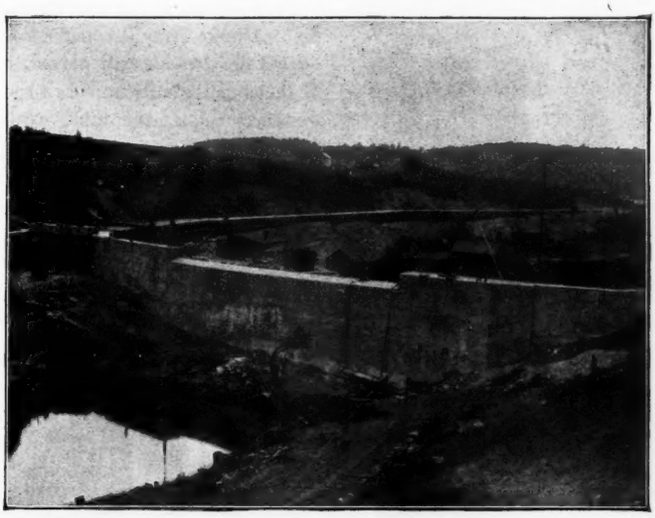


Fig. 4.—The St. Croix Power Company's Dam and Flume Looking Down Stream.

Across the terminals of the main transformer leads is connected a small transformer supplying in its secondary circuit, an electro-motive force in step with, and proportional to that of the generator. In series with the main transformer leads is a small series transformer which supplies in its secondary circuit a current always in step with and proportional to its primary current. The secondaries of the two transformers are connected in series through an inductive resistance and an ohmic resistance. Both the inductive resistance or reactance and the ohmic resistance are so adjusted that for a given current through them, their respective electro-motive forces have the same value relative to the electro-motive force of the potential transformer as the reactance and resistance electro-motive forces of the transmission circuit have to the electro-motive force of the generator. Therefore, the local reactance and resistance electro-motive forces reduce the electro-motive force supplied by the potential transformer to a potential indicator connected in this local circuit, in the same proportion as the line reactance and resistance electro-motive forces cut down the generator voltage, and thus the potential indicator at the generating station is made to indicate the voltage at the point of distribution.

The local service switchboard panel is equipped with switches for controlling the electric heaters by which the power-house is warmed, also the incandescent and arc lighting circuits and the motors driving the blowers.

There have been installed six air-blast transformers of 500-kilowatt capacity each, which step the voltage up directly from 800 to 25,000 volts. As operated, the transformers are connected in two sets of three each with "Y" connections. The low-tension side of each set of transformers is joined directly with the transformer panel switches, and the high-tension side with Westinghouse "spider" switches, through the use of which either bank of transformers may be connected to either or both of the transformer circuits.

All the electrical apparatus in the power plant was furnished by the General Electric Company, except the high-tension switches and the alternating-current arc lamps, which latter were purchased from the Manhattan General Construction Company. These lamps are of the enclosed type and require 6.6 amperes. They are operated in series directly from the 800-volt bus-bars, there being eight lamps and regulator in each circuit.

A 20-ton hand crane, traveling the entire length of the dynamo-room, affords a convenient method for handling the heavy machinery.

(To be concluded.)

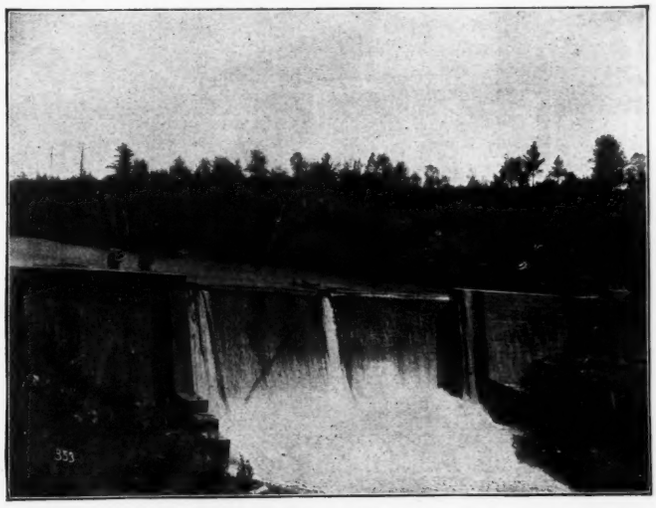


Fig. 5.—St. Croix Power Company's Dam and Spillway.

Japanese Navy to Use Marconi System.

What are supposed to be the most powerful wireless telegraph instruments ever manufactured were recently exhibited at a showroom on Fifth avenue, New York city. They were on exhibition before being sent to Japan, where they will be used by the Imperial Japanese Navy. There are two of the instruments and they will be installed in two of the crack Japanese cruisers. If expectations are fulfilled they will transmit messages 125 miles. The apparatus is somewhat in the nature of an experiment, though constructed after Marconi's system according to his principles, but, in spite of some adverse comment, the exhibition proved a success and it is now believed probable that much more powerful instruments will be constructed. The machines in question develop a high voltage, the induction coils containing over 125 miles of copper wire and weighing about 150 pounds. A spark 45 inches long is given by the coil. For each sender a powerful receiver has been made. These have the appearance of corresponding machines used in ordinary wire telegraphy, and in the experiments which the Japanese Government proposes to make with these instruments results are expected which have never before been obtained with similar apparatus.

An Alternating-Current Series Enclosed Arc Light System.

Perhaps of all the innovations that have been introduced in electric lighting during the last decade none has been of more importance than that of connecting a series of arc lamps upon alternating-current circuits fed by appropriate mechanism with a constant current suited to the capacity of the lamps. The accompanying illustrations exhibit a carefully worked-out system of this character which is complete in all of the various details necessary in such an installation. The lamps are designed to operate on constant current, the only limitation to the number that can be connected in series being that each must be supplied with not less than 80 volts at its circuit terminals. The lamps are built on the shunt principle, and each is provided with an automatic cutout and a substantial hand switch, the working parts of both of which are placed under a casting at the top of the frame which fully protects them from the weather and mechanical injury.

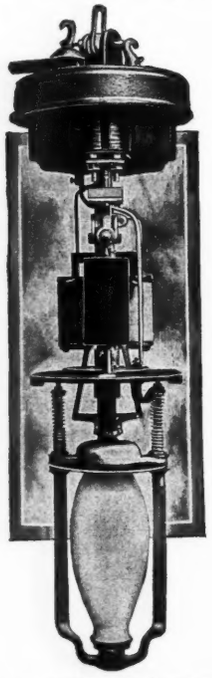


FIG. 1. ALTERNATING-CURRENT ARC LAMP—SHOWING MECHANISM.

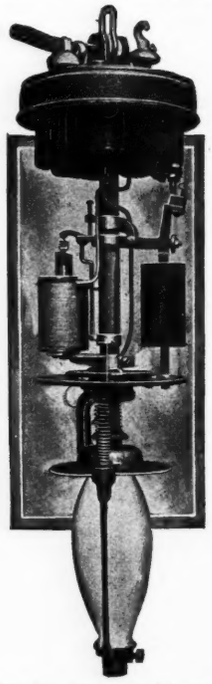


FIG. 2.—ANOTHER VIEW OF THE LAMP MECHANISM.

FIG. 3.—LAMP WITH ROUND OUTER GLOBE.

FIG. 4.—LAMP WITH METAL REFLECTOR.

Reference to the illustrations gives an excellent idea of the mechanism of the lamp. Upon the feed lever are balanced at one end a U-shaped laminated iron core, and at the other a lead weight. The legs of the U-shaped core are surrounded by two shunt coils connected across the arc and the clutch operated directly upon the fed carbon as is customary in lamps of this class. The voltage at the arc itself is the same as that at the lamp hangers, and the only loss in the lamp is claimed to be that consumed by the shunt regulating coils which absorb from five to six actual watts, or from 10 to 12 apparent watts. It is claimed by the makers, the General Incandescent Arc Light Company of New York, that the efficiency of the lamp is over 97 per cent, while its power-factor is from 85 to 90 per cent. The lamp weighs about 25 pounds complete, and is a little over 25 inches long. It is made to carry half-inch carbons, the upper carbon being nine and one-half inches long, and the lower five and three-quarter inches long. In ordinary normal service the life of one pair of carbons varies between 75 and 90 hours, dependent, of course, upon the grade of carbon employed.

The regulator supplied in connection with this system is designed to keep the current constant upon the circuits connected with it. Its source of supply may be either primary or secondary. From 80 to 90 volts should be provided, in the case of primary connection, per lamp. It is considered advantageous to use a transformer between the generator and each lamp circuit, partly for the reason that the usual pressures for constant potential circuits are not high enough to permit long circuits of lamps to be burned upon them, and also because any disturbance in the primary part of the system is avoided should any part of the arc circuit become grounded. The regulator is connected in any point of the circuit in series with the lamps. It is said that the loss in the regulator at all loads from short circuit to full load is constant, being simply the copper and iron loss of the machine, figuring out about 140 watts on a 25-light regulator adjusted for 6.8 amperes on 2,200 volts, 60 cycles current. It is claimed that these regulators have an efficiency greater than 98 per cent, and that they regulate within one-tenth of an ampere.

The regulator consists of two reactance coils connected in series with the lamps in which is a laminated U-shaped core so suspended that it can play up and down in the field of the coils. When the system is not operating only a small portion of the legs of the core are surrounded by the windings of the coils. If the outside line is short-circuited and current turned on, the core is immediately drawn up into the coils, which then react against the line potential and keep the current constant at the value for which the regulator is adjusted to operate. Whatever the number of lamps in circuit may be the core automatically takes the necessary position to regulate the current through the circuit at a fixed and constant amount. Attached to the movable core is a dash-pot in order to prevent sudden fluctuations and arrest the natural tendency of the movable core to vibrate about its position of rest. The whole system has been carefully worked out, and it is claimed that it operates with great satisfaction under the usual conditions met with in practice.

A large storage battery has been contracted for by the Baltimore & Ohio Railroad, which has given the order to a Philadelphia electric storage battery manufacturer. The cells of the battery will consist of 320 tanks, each made of hardwood and lined with lead, 39 plates being contained in each tank. The weight of each tank, with its plates and solution, will be about 1,800 pounds, and the complete battery will possess an energy of 1,200 horse-power for a short period of time.

Train Lighting by Electricity.

At the recent session of the International Railway Congress, in Paris, reports were made in relation to the important question of train lighting, embodying a complete résumé of the various methods of lighting railway carriages which have obtained on the continent and in the United Kingdom from the earliest days of the railways to the latest improvements and perfections, including electric lighting, acetylene, gas, etc. The first of the reports was prepared by Mons. Chaperon, engineer and chief of a division of the Paris, Lyons & Mediterranean Railway Company, in collaboration with Mons. Herard, assistant chief of transportation of the Orleans Railway Company, and embraced all the countries of the continent and the United Kingdom, except Austria-Hungary, Roumania, the Netherlands, Luxembourg and Germany.

The above-named countries not embraced in the first report were included in the second report, which was prepared by Cajetan Banovits, a ministerial councillor and director of rolling stock and locomotives of the Hungarian State Railways. It is to be regretted that so little information was furnished by the railways of Germany and the United States, but the information derived from the experience of the other countries has enabled the presentation of a valuable contribution to the knowledge of the subject and a comprehensive comparison of the various methods employed.

The early methods of lighting by means of candles and oil—animal, vegetable and mineral—some of which still obtain on some of the smaller lines on the continent, are reviewed exhaustively and their merits and defects quite fully set forth. Gas and electric lighting—the two great systems now competing for favor in this country as well as abroad, including under the former gas from petroleum and other mineral oils, pure acetylene and gas mixed with acetylene; and under the latter the systems of electric lighting from storage batteries alone and from storage batteries in connection with dynamos—were discussed in these reports at some length.

In the report by MM. Chaperon and Herard is set forth the merits and deficiencies of each system. It says:

"They (the railway companies) have aimed at a result, if not perfect, at least very satisfactory, by different methods, either in perfecting the apparatus for using oil or petroleum, or in multiplying their number, or by recourse to new and altogether different systems, *viz.*: gas and electricity. With oil lighting the expense of installation is comparatively low, but it requires a numerous staff for cleaning, filling and maintaining the lamps. It is requisite that this work be carefully done, as the quality of the light and the economy of the system depend absolutely on the

FIG. 5.—REACTANCE COIL—OPEN AND CLOSED

manner in which it is done; finally, the quality of oil wicks, etc., have first importance. All these necessary conditions require that good oil or petroleum lighting

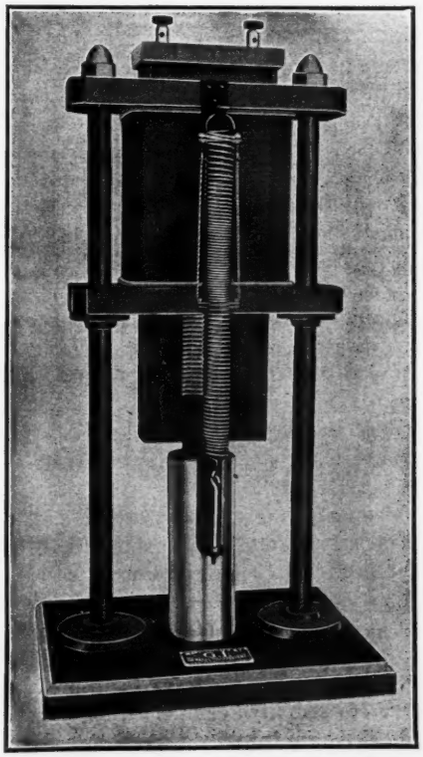


FIG. 6.—REGULATOR FOR SERIES ALTERNATING-CURRENT ARC SYSTEM.

brings the cost per lamp-power to quite a high figure.

"In gas lighting the cost of installation for the manufacture and supply of the gas is quite considerable. . . . The expense for labor is reduced to the minimum, the services of the staff being limited to wiping the cups and chimneys of the lamps, the examination of the burners and supplying the reserves or tanks of the carriages. The advantages of the system are principally in the quality of the lights, the facility of modifying the intensity, as well as the simplicity of the labor in maintenance and cleaning and in the activity in filling the supply tanks.

"The lighting power of the gas may be still improved by mixing it with highly carburetted products. Several of these have been made use of, among others naphthaline (albo-carbon) which has not given very good results. Acetylene mixed with gas in the proportion of 25 to 30 per cent gives the flame a very considerable intensity and fixity."

Coming to the question of lighting by electricity the report says:

"Electric lighting is, without contradiction, that which is presented under the most attractive form. Incandescent electric lamps have, in fact, an incontestable superiority over all other methods of lighting, as much from the point of view of comfort as that of facility of installation of luminous centres, which may be as intense as desired and which can be placed at the most convenient points for the passengers.

"They produce no, or next to no heat, and there is no occasion to provide for the products of combustion being carried outside.

"The electric lighting of the carriages produced by means of a dynamo driven by the axle during the run of the train, realizes, in principle, a complete and rational system of lighting."

This report concludes with a query for discussion as to whether the equipment provided to assure constancy of tension will be likely to deteriorate in service, and whether its maintenance will be expensive. Also whether regular inspections of the parts will tend to cause too great a degree of immobility of the rolling stock.

In a later article will be abstracted the discussion which took place at the congress on the several points submitted, as well as the report submitted by Cajetan Banovits for the other European countries not covered by the first.

A report from California states that the Santa Barbara electric road is to be extended to Summerland, and that within a very short time, the route having been already graded and poles set most of the way. For some unknown reason the scheme was abandoned some time ago, but as that portion of the county has been rapidly increasing in population, and as the extension will be a great convenience to the Montecito people, it is thought it will be a paying investment.

Views, News and Interviews

King Leopold, of Belgium, is an enthusiastic believer in automobiles and has recently been making inquiries regarding additional vehicles for his personal use, and a large wagonette or carryall to be in attendance at the palace for the transportation of state and visiting functionaries of high degree.

The hackney coach proprietors and cab drivers of Naples are more enterprising than the London ones, observes the *London Daily News*. They have formed themselves into an electromobile company for the purpose of transforming the hackney coaches and carrozella into automobiles within three years, their desire being thus to forestall any foreign society that might introduce the new mode of locomotion.

It has frequently been said that the fender attached to an electric car is of no practical value in the prevention of serious accidents, but this does not appear to be quite true, as two recent mishaps in Liverpool, England, prove. One afternoon an Irish pig confined in Gill street market-stalls succeeded in escaping from his pen and ran out into the London Post Road, where he attempted to root an electric car up with his nose and push it off the track. The mistaken animal was knocked down, picked up by and safely landed on the fender, where it sat squealing in piteous accents until removed. The other accident is of a more serious nature. A little girl, about eight years old, in attempting to cross a street, was knocked down by a tramcar, but was picked up and safely carried about 60 feet on the fender, receiving only a few bruises of no great account on her forehead, thus proving the efficacy of the fender.

A writer in the London *Sphere* is evidently very much disturbed over England's dreadful predicament and the distress with which it views the increasing spread and broadening prospects of rapid transit over there, remarking dolefully: "The prevalence of motor cars opens up a very awful vista in the future. Some people can not bear the sound of railways; they dislike the din, rattle and dust. But what is to be done with motor cars causing the same annoyance along the rural road? No longer can children play in country lanes, or the quiet pedestrians gather wayside flowers; no longer can the nursemaid go for a stroll with the baby in the perambulator, or the lame man warm himself in the sunshine. The whole of England will be one vast railway track, the silence of the fields broken by shrill whistles and harsh rumbling sounds, while the dust flies around in clouds, blinding and confusing those who presume to attempt to admire the beauties of nature."

Parisian firemen recently gave an exhibition drill with automobile fire engine apparatus of an improved character, all three types of machine used having been previously exploited in the drill at Vincennes. The apparatus consisted of an electrical hose wagon with a capacity of six men, life-saving tackle, ladders and the usual hose reel, and an electric fire pump of an entirely new type consisting of a metallic tank of 100 gallons capacity mounted on an automobile carriage, with pump, hose and nozzle. The apparatus for pumping the water is operated by the same motor which drives the engine, which, on arrival at the fire, is switched off to the pump, thus serving a double purpose. The hose is wound on a cylindrical reel so fixed that on arriving at a fire the stream is immediately available and the capacity of the tank is exhausted while the hose from the hose-cart is being attached to the water main. The engine weighs, in running order, with its crew and a full tank, a trifle over three tons. The apparatus on both engine and hose wagon is so constructed that part of the energy generated may be used for the lighting of arc and incandescent lamps during night fires. The third vehicle is an electrical ladder. This is mounted upon a low truck upon which the large ladder used by the department is hoisted almost horizontally by means of an inclined plane, to the perpendicular, the weight of the apparatus, including its crew, being over four tons and a half, or the heaviest of all the fire machinery to which mechanical propulsion has been applied. On account of the peculiar difficulties presented in its successful manœuvering it was necessary to insure the perfect stability of the ladder-truck, especially in turning corners at a high speed. This has been done with such success that the electric machine is much more stable than those drawn by horses, its centre of gravity being much lower. The capacity of its accumulators, as well as those of the pump and hose cart, is sufficient to run up to 36 miles at 12 miles an hour without recharging.

PERSONAL.

Mr. B. M. Barr, who for several years has been the New York manager for the Stirling Company, of Chicago, manufacturers of water-tube boilers, will sever his connection with the company on January 1. Mr. Barr is very well known in the electrical industry, with which he has been prominently connected for nearly 20 years.

Mr. John M. Klein, of the John M. Klein Electrical Works, San Francisco, is en route for New York and is spending this week in Chicago. Mr. Klein is an old-time telegrapher, having been connected with the Western Union in New York city from 1869 to 1875. Since that time he has been in the electrical supply business in San Francisco.

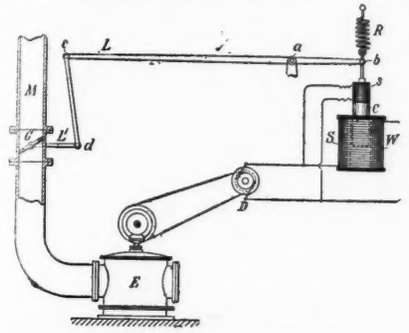
Mr. H. B. Kirkland, of New York city, who has been connected for many years with the American Circular Loom Company, of Boston, Mass., has been appointed general sales manager of the company. Mr. Kirkland is well known to the electrical fraternity throughout the United States, and his promotion to the important position he now holds will, without doubt, be a source of gratification to his many friends.

The engagement is announced of Mr. William Benton McCurdy, formerly of Chicago, to Miss Estelle Myrtis Dwight, daughter of Mr. and Mrs. W. B. Dwight, of the same city. Mr. McCurdy is the general manager of the American Electric Fuse Company, of Chicago, and has recently established a branch office at 116 Nassau street, New York city, where he has entire control of the company's eastern business.

Miss Maria Woodward Baldwin, daughter of Mr. and Mrs. William H. Baldwin, of Baltimore, was married on November 27, at Grace Protestant Episcopal Church, Baltimore, to Mr. Samuel McClintock Hamill, of Schenectady, N. Y., and formerly of Trenton, N. J. The maid of honor was Miss Sarah Baldwin, sister of the bride, and Mr. A. Butler Duncan, of New York, was best man. A reception was held at the residence of the bride's parents, after which Mr. and Mrs. Hamill went north on a wedding tour. They will make their home at Schenectady. Mr. Hamill is well and popularly known to the electrical fraternity as the recent president of the Siemens-Halske Electric Company, and through his long connection with the Brush Electric Company, of Cleveland, and the General Electric Company, of Schenectady, with which he now holds a prominent position.

Recent Electrical Patents

As is well known, the governors usually used for controlling prime movers—such, for example, as the common centrifugal governor—are dependent for their action upon a change of speed in the prime mover itself, so that the governor will not act until the speed of the prime mover has actually changed. These defects in the ordinary governing apparatus are especially objectionable when the prime mover is

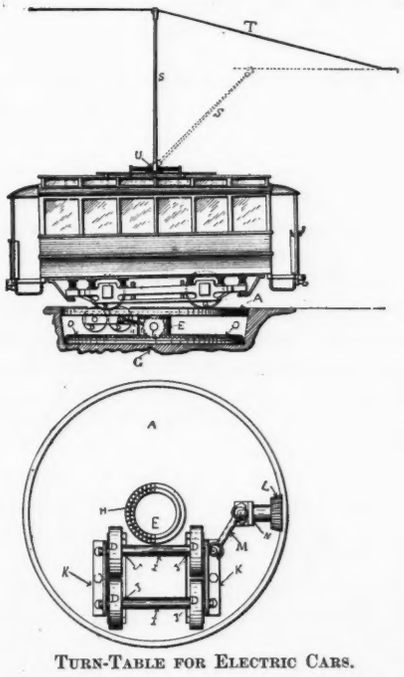


Electrical Governing Device.

used for driving an electrical generator, since a very uniform speed of the generator is highly desired. To overcome these objections, Ralph D. Mershon, a resident of New York city, has devised a method for governing the prime mover of an electrical generator, which is not primarily dependent for its action upon a change of speed in the motor governed by it, but which assumes a definite position for every load thrown upon the mover without regard to its speed. The invention consists, broadly stated, in making use, as a controlling element, of the governing apparatus of a wattmeter or power indicator forming part of or connected with the prime mover so as to be responsive to changes in the load upon it, and it consists further, in using as a controlling element or elements of the governing apparatus, such a wattmeter in combination with a speed indicator connected with or actuated by the prime mover. Thus, where an electric generator is carrying a variable load, whose variations are due to the variations in electro-motive forces or current, the electro-motive force and current produces a magnetic resultant, and the variations thus caused in the magnetic resultant produce corresponding variations in the driving power applied to the generator and an approximately constant speed.

Mr. Andrew M. Riker, of Stamford, Ct., the inventor of the Riker automobile, has been granted a patent on an important improvement in the running gear for automobiles or motor vehicles. In the usual construction of these machines, the driving axle is generally divided and provided with differential gearing, which permits the necessary different speed of the wheels when turning a corner. In the present invention, the necessity of the divided axle is obviated, and both the front and rear axles are each made of a single piece, whereby they are greatly strengthened. These axles are connected by side bars which are suitably braced. In order to provide for the necessary difference of speed of the driving wheels, Mr. Riker employs a separate motor for each driving wheel, each of which is arranged adjacent and connected to the wheel by means of ordinary spur gearing.

An ingenious turn-table for electric cars has recently been patented by Otto G. Rieske, of Dayton, Ohio. It consists of an ordinary turn-table rotably mounted and having the usual tracks. This table

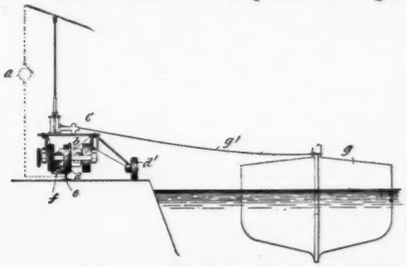


Turn-Table for Electric Cars.

is provided with two slots, through each of which extend two friction wheels arranged in line with and forming a part of the tracks. The shafts upon which these wheels are mounted are suitably geared with a pinion that is mounted upon the under side of the table and meshes with a geared track solidly mounted against movement beneath the same. In operation, the car is run upon the table until one pair of wheels rests upon the friction wheels. The current is then turned on. The motor controlling this pair of car wheels, rotates them, and in turn rotates the friction wheels, which, of course, operate the pinion and rotate the table. In order to keep the trolley upon the wire, which is arranged over the table, the pole is swiveled to permit a free turning of the car while the trolley wheel remains stationary. After the car has thus been turned, the motor of the opposite wheels is started, thus pulling the others from the friction wheels and permitting the car to be drawn over the table, but leaving it in position.

Mr. Robert B. Robertson, of Topeka, Kas., has devised a motor that can be applied to any road vehicle to convert it into a horseless carriage. His manner of doing this is to provide a platform which can be suspended under the carriage body by means of suitable hangers, and which carries a suitable motor and power to operate the same. This motor may be of any appropriate character—as electric, steam and the like—and is connected to a rotable shaft. The ends of the shaft are provided with friction wheels which are arranged to make contact with the ordinary vehicle wheels of the carriage to rotate them.

In view of the proposed method of operating canal boats by electrical power, inventors have turned their attention to means for propelling them, and one of the most interesting patents in this line has been recently issued to a German, who assigned it to the Siemens & Halske Electric Company, of Chicago, Ill. The inventor has designed a motor that runs on a single rail along the edge of the canal, and to which the canal boat or object to be towed is connected in the usual manner by an ordinary cable or tow line. The motor is provided with a set of two or more traction wheels which are disposed in align-



Operating Canal Boats by Electric Power.

ment and bear upon the single rail. The weight of the motor is so distributed that substantially all of it is carried upon this set of traction wheels, and additional wheel or wheels being provided at one side of the motor for the purpose of giving stability, which wheels preferably find their support upon the towpath. The traction wheels are provided with coacting rollers which engage the side of the rail head and prevent the motor from being drawn from its position upon the rail. Should the tractive movement not be enough, a gear wheel and rack may be used in connection with the traction wheels.

Wall Street and the Electrical Stock Market.

This week the market has been less active than last week and prices have been very irregular. There was a tendency for investment and many commission firms had orders for bonds. In several instances prices have advanced during the week, especially in railroads, the industrial quarter being rather reactionary. Though there is no news of any kind to justify such fluctuations, conditions and future business prospects being excellent, as shown by railroad reports, which indicate an increase in traffic, many contradictory rumors were spread through Wall street, most of them without any reason. Since the election evidences of renewed activity and prosperity in the copper trade have multiplied and the volume of business has been on a decidedly larger scale. Domestic manufacturers have taken liberal quantities of copper, paying as high as 17 cents for time contracts. The outlook for a long stretch of prosperity in this established line is distinctly strong.

On the New York Stock Exchange, General Electric closed at 167½ bid and 168½ asked, showing no change. Metropolitan Street Railway, of New York, closed at 171 bid and 171½ asked, indicating a loss of 2 points. Brooklyn Rapid Transit closed at 72½ bid and 72¾ asked, showing a loss of 1¾ points for the week. Third Avenue Railroad closed at 113 bid and 114 asked, showing a gain of 1 point for the week. A prominent firm of bankers offers for subscription ten million dollars of Third Avenue Railroad Company's first consolidated mortgage four per cent one hundred year gold bonds. These bonds form a part of the total authorized issue of fifty million dollars, of which $15,443,000 are reserved to retire the outstanding bonds of all other issues of the Third Avenue Railroad Company and its controlled lines. The bonds are payable January 1, 2000, and the principal and interest are guaranteed by the Metropolitan Street Railway Company. The price at which subscriptions are requested for the bonds is 104½ and accrued interest. Manhattan Railway, of New York, closed at 109 bid and 109¼ asked, indicating a loss of 1¾ points for the week.

On the Boston exchange, American Telephone and Telegraph closed at 158½ bid and 159 asked, showing a loss of 1½ point in the bid price. Erie Telephone closed at 109½ bid and 111 asked, indicating a gain of 2½ points for the week.

On the Philadelphia exchange, Electric Storage Battery closed at 87 asked and no bid price quoted. The directors of the Electric Storage Battery Company recently resolved to pay the cumulative dividend accrued on the preferred stock from January 1, 1895, to December 31, 1900, amounting to $6 per share. Checks for this dividend will be mailed on January 2, 1901, to stockholders of record at the close of business, December 20, 1900. The transfer books of the preferred stock will be closed from December 21, 1900, to January 1, 1901, inclusive. Electric Company of America closed at 10 bid and 10⅛ asked, showing a loss of ¼ point for the week. Union Traction closed the week at 34¼ bid and 34½ asked, indicating a loss of ¾ point for the week.

On the curb, or outside market, in New York, Electric Vehicle closed at 17 bid and 20 asked, indicating a loss of 2 points. Electric Boat closed at 18 bid and 20 asked, showing no change for the week. Consolidated Equipment closed at 14¼ bid and 14½ asked, showing a gain of 1¾ points for the week.

Wall street, December 1.

Westchester Lighting Company.

The Westchester Lighting Company has been formed in Westchester County, New York, and will absorb all the other gas-electric light companies in each township throughout Westchester County. Certificates of increase of capital stock of the company from $2,500,000 to $12,500,000 were filed in Albany and in White Plains last week. The certificate says that of this sum $10,000,000 is common stock, consisting of 100,000 shares of the par value of $100 each and $2,500,000 is preferred stock of the same value.

The directors of the new organization comprise Charles H. Werner, Louis B. Grant, Richard F. McKirney, M. J. Warner, Charles M. Heminway, N. D. Daboll, Henry A. Kenworthy, Charles W. Squires, W. W. Scrugham and Reginald H. Giles. The papers were drawn up by ex-Lieutenant-Governor Sheehan. The new corporation will erect several extensive plants throughout the county as soon as it obtains new franchises and rights.

W. W. Scrugham is president and B. W. Stillwell, secretary. Those behind the combination are said to include William C. Whitney, P. A. B. Widener and A. M. Young. William F. Sheehan is the new company's counsel.

The property of the following concerns has been turned over to the Westchester Lighting Company: East Chester Electric Company, Port Chester Electric Lighting Company, Larchmont Electric Light Company, Hugenot Electric Light, Heat and Power Company, the Pelham Electric Light and Power Company, Mount Kisco Lighting Company, Westchester Gas and Coke Company, New York Suburban Gas Company, White Plains Lighting Company, Hudson River Gas and Electric Company, Municipal Gas Company of Yonkers, the Yonkers Gas Light Company and the Westchester Gas Light Company of Yonkers.

Independent Telephone Stock Assessed.

An assessment of 10 per cent, or $5 a share has been levied upon the capital stock of the Telephone, Telegraph and Cable Company of America. A circular from William J. Latta, the company's president, that has been sent to the stockholders, says: "Certain negotiations looking toward a change in the character of your interests have reached that point where it is reasonably sure that they may be submitted to you for consideration within 30 days. The notice for an assessment was deemed necessary by your board to protect the interests of your property should further delay intervene in the final adjustment of plans referred to."

Another Niagara Power Scheme.

A press despatch from Lockport, N. Y., states that the Niagara, Lockport & Ontario Power Company will build a great power plant rivalling in extent the famous plant of the Niagara Falls Power Company, and will construct a big water conduit from Lake Ontario to Lockport to supply that city with water, cut a wide power canal from the Niagara River to Lockport and build a power transmission line to Depew, where are located the shops of the New York Central & Hudson River Railroad. At the date of the despatch the common council and a mass meeting of Lockport citizens were discussing the matter. The Lockport & Newfane Water Supply Company also wants to establish a water supply for Lockport from Lake Ontario, 12 miles away. This company is said to be backed by the International Traction Company and is making a contest for the water contract. The first mentioned company holds a franchise for a power canal and has given the city of Lockport to understand that if the city gives it the water contract the company will build the great canal. It is said to be ready to buy the right of way, which will cost $1,000,000, build the conduit from Lake Ontario which will cost another $1,000,000, and construct the power canal from the Niagara River, which will cost $8,000,000. It is intimated that the Vanderbilt interests are largely concerned with the latter company.

Alternating Magnetic Fields as a Therapeutic Agent.

An exceedingly interesting series of experiments has been carried on lately by Mr. John Burry, of 69 Broadway, Brooklyn, upon the effect of alternating fields of magnetic force upon various inflammations and diseases of that class in which pain is caused by failure of the natural circulating and draining functions of the part affected. The apparatus in use is exceedingly simple, consisting of solenoids of a size convenient for the admission of various parts of the body or of the whole body of the patient, and directly actuated by alternating current at a frequency of 60 cycles per second. It is claimed that the pain of rheumatism is eliminated in from 10 to 15 minutes and does not return for some time after the use of this apparatus. It is said also to have proved remarkably efficacious in the treatment of writer's and telegrapher's cramp, and very successful in the treatment of toothache when this is caused by diseased conditions of the jaw-bone. Mr. Burry has maintained for some time past, at the address above, what is practically a free hospital in which he has treated a large number of patients for the purpose of acquiring experience and making observations upon the effect of this singular application. While hesitating to express any theory of the action of the apparatus he is firmly convinced that it produces extraordinary activity in the various osmotic and other functions of the cells of the afflicted tissues, and he has had the gratification of producing what are, at least apparently, cures in a number of more or less difficult cases. So far this application does not seem to have been investigated fully by electro-therapeutists or under hospital conditions, but from the various accounts that are received it is at least an interesting, if not a highly useful, application of electricity in the relief of suffering and the cure of disease.

An Accident That Electricity Would Have Prevented.

On November 8 a collision at Offenbach, near Frankfort, Germany, resulted in an explosion of the tank of gas used for lighting the train and the two rear coaches were burned with the loss of life of some 12 or 15 persons. The accident was a peculiarly horrible one and has created quite a sensation in Germany, and the press and public there are considering the use of electricity for train lighting in comparison with gas for the same purpose; this notwithstanding the very large investment in that country in gas works and in gas development.

It is evident that the day is fast approaching when the great field of lighting of the steam roads of the world will be filled by electricity, which does not explode. Its economy and convenience have been proven, as is evidenced by the recent successful installation by the Atchison, Topeka and Santa Fé Railroad, of what is known as the axle equipment for lighting and ventilating its cars. Other leading roads of this country are contemplating the adoption of electricity, and it is believed that the progressive lines of the country will soon be using it.

Roentgen Society of the United States.

The Roentgen society of the United States has issued a final notice to manufacturers of X-ray apparatus, inviting them to exhibit at the coming meeting of the society. A floor space of 2,000 square feet has been engaged for exhibition purposes and a 115-volt, direct-current power circuit will be available for the exhibitors. To secure larger facilities the place of meeting has been changed from the Academy of Medicine to the Grand Central Palace, Lexington avenue and Forty-third street, New York. The meeting will be held on December 13 and 14. S. H. Monell, chairman of the committee on arrangements, 47 West Twenty-seventh street, New York, says that all indications point to a most successful meeting.

Members of the New York Electrical Society, as well as all physicians and surgeons are especially invited to attend. The programme announces 21 papers, and important novelties will be presented.

New York Electrical Society.

The two hundred and tenth meeting of the society will be held at the College of the City of New York, Twenty-third street and Lexington avenue, on Wednesday, December 12, at 8 P. M.

Dr. Samuel Sheldon will lecture on "Electrical Measurements of Precision." The lecture will include: 1. Recent improvements of methods for electrical measurements of precision. 2. Distinction between commercial measurements and those of precision. 3. Distinction between absolute measurements and those of comparison. 4. Present standards. 5. Methods of comparing standard resistances of all magnitudes. 6. Methods of comparing electro-motive forces. 7. Current measurements. 8. Standard illuminants and their comparison.

The following standards will be exhibited: one ohm, 0.01 ohm, Reichsanstalt Clark cell, Carhart cell, Reichsanstalt compensation set, Hefner-Alteneck lamp, improved Lummer-Brodhun photometer screen.

After Dr. Sheldon's lecture some remarks will be made by the president on "Lighting at the Paris Exposition," with some night views.

Telephone Franchise Controversy in Tennessee.

The ordinance recently granted by Chattanooga, Tenn., to Thomas S. Wilcox and his associates, caused a local paper to come out with a protest of more than a page, under the caption of "A mighty torrent of opposition—Citizens protest against granting without restriction of telephone franchise—Sacred rights of the people clandestinely bartered without restraint—A franchise of inestimable value sacrificed freely—The people's only hope of reclaiming it is through the mayor's vote—Mayor is non-committal—Ex-City Attorney Cantwell dissects the ordinance—Representative citizens unstinted in condemnation of its lack of safeguards of the people's rights."

The portion of the franchise to which the newspaper objects is section three. At first blush the ordinance does not seem to be any different from that usually granted, but a canvass of public opinion made by the newspaper seems to indicate that the majority of citizens are very much opposed to it, considering the granting of the franchise for nothing, somewhat in the nature of a robbery of the city treasury, various local men claiming that it is worth at the very least $25,000. In its editorial on the subject the paper referred to says: "Eminent lawyers express the opinion that the franchise as passed is valueless, but in the mind of the rank and file its legality or irregularity is lost sight of in the more important matter of its passage at all under the circumstances." The circumstances to which the paper refers consist of the poor service and independence of the company which now has telephones in the principal stores and offices in Chattanooga, and public opinion seems to be about evenly divided on the score of having an opposition company.

Ill Treatment of American Horses in England Disproved.

At a recent meeting in St. James Hall, London, England, the statements current of the brutality of American jockeys to American horses racing on English turf were proven unfounded and the rumors of their having tortured the animals with electric belts were absolutely untrue.

International Wireless Telegraphy.

London, England, cablegrams to New York assert that Mr. Marconi has stated that he has solved the difficulties of transoceanic wireless telegraphy and that he expects to establish permanently such communication between the United States and Great Britain during 1901.

Electric Railways

The street railway between Huntington and Central City, W. Va., is being rebuilt on the most modern lines.

A company which will invest $2,000,000 intends to build an electric road from Toledo to Defiance, Ohio. Rights-of-way have been obtained along almost the entire route.

Certificates have been filed with the Secretary of State by the Amsterdam, N. Y., Street Railroad Company for the extension of its line through several villages to Hagamans.

Work on the extension of the South Thirteenth Street electric line, in Terre Haute, Ind., has begun and is rapidly progressing. Other extensions are expected to follow in the near future.

Unless present indications are at fault, the Columbia-Montour, Pa., Electric Railroad will be soon in process of construction. When completed the road will run through Riverside and other intermediate towns to Nescopeck.

The contract for building the power house and barns of the Toledo, Fostoria & Findlay, Ohio, Electric Railroad has been sublet by the Dover Construction Company to a local contractor who will commence work at once.

Contracts have been let and work commenced on the power house and car barn of the Orange & Erving, Mass., Street Railway Company. The track will not be laid until Spring, but all the buildings will be completed by next Fall.

The Tacoma common council has granted a franchise to the Tacoma Railway and Power Company for the construction of a line which will enable its city-bound South Tacoma cars to avoid the crossing of the De Lin street bridge.

A franchise has been granted in Ionia, Mich., to the company which intends to run an electric line along the north side of Grand River, from Ionia through Saranac and intermediate points to Valley City. The line will be single tracked.

Contracts for supplying the cars for the new electric railways now being constructed in Paisley, Scotland, have been awarded to an English firm, and the overhead equipment to an American supply house. The cost of the entire system is estimated at $500,000.

The Greenock, Scotland, municipality has awarded the contract for the conversion of the present traction system in that city to an electric line to a London, England, firm for £90,000. Tenders for overhead equipment and rolling stock for the new line will shortly be advertised.

The People's Telegraph Company, of Wilmington, Del., has awarded contracts for its car barns and power house, which are estimated to cost about $40,000. The barn when first completed will hold 50 cars and will be so planned that its capacity can be enlarged as required.

A project is said to be on foot to build a line in Michigan along the lake shore from Saugatuck. The new company is a separate organization, but it is believed that it will have close relations with the Grand Rapids, Holland & Lake Michigan Company. The line will be built next Summer.

The route over which the Sherman County extension of the Chattanooga, Tenn., electric street railway line will run has been selected, and bids for material will soon be asked. The line will run over the present Harrison avenue tracks through Avondale, Stanleytown and East Chattanooga to Hills City.

An attempt was made one night recently to wreck a car on the Newark & Granville Electric Line. Fence rails and other obstructions had been placed on the track and one car ran into the obstruction, but the motorman saw it in time to prevent serious results to the passengers. The car, however, was badly damaged.

New boilers and generators are now being installed in the power house of the Memphis, Tenn., Street Railway Company which will add 4,000 horse-power to the present energy of the plant at a total cost of $78,000. The present system is not adequate for the needs of Memphis, but it is believed that the new machinery will fulfill all requirements.

The London, England, county council has determined to institute a service of electric cars throughout the metropolis, and tenders have been offered by American, British, French and German firms for the conversion of the Metropolitan Underground Railway to an electric road. The minimum cost is estimated at £5,000,000. Bids were opened on December 1.

A syndicate which owns the Exeter, Hampton & Owensburg, N. H., Street Railway has purchased the Union Electric Railway, of Somersworth. The new officers of the road are Messrs. Wallace D. Lowell, A. Pride, A. H. McReel and J. E. Winn. An extension of the line to Rochester is planned and several important improvements at the park will be made.

A company soon to be chartered in Athens, Ohio, will have a capital of about $1,000,000, and will be known as the Athens, Nelsonville & Hocking Valley Traction Company. It will be 35 miles long, and have termini in Athens and Nelsonville. The promoters of the line are H. H. Haning, of Athens, and several prominent business men of Dayton.

The Southern Ohio Traction Company, which owns and operates the interurban system between Cincinnati and Dayton, is contemplating an extension of its line from Dayton to Toledo. Should this plan be carried through, it would form one of the longest continued lines in the whole country. A large portion of the line is already built and some sections are building.

The Cincinnati, Ohio, Street Railway Company is seeking additional franchises in the village of Norwood, one of the important suburbs of the Queen City. A meeting of the village council recently showed that the majority of the members were opposed to the grant under the proposed terms. Unless greater concessions are granted the franchises will not go through.

Officials of the Manhattan Railway Company, of New York city, are reported to have said that the third-rail system on the Second avenue elevated will be in operation about Christmas time. A speed of 16 miles an hour will be maintained and the change will reduce the running time from South Ferry to One Hundred and Twenty-ninth street about 10 or 12 minutes.

The Santa Ana & Orange Motor Road, of Orange, Cal., has been granted a franchise for an electric line in Whittier. The road now runs only from Santa Ana to Orange and is operated by steam dummies, but under the new franchise it will be converted to an electric road and will cover a number of towns in the vicinity with a view to building up Santa Ana as a commercial centre.

A franchise has been granted to the Lynn & Boston, Mass., Street Railway Company to operate a line between Lynn and Boston over the old turnpike, known as Highland avenue. The distance will be covered in an hour and 15 minutes and a flat fare of 15 cents will be charged. The total cost of the road will be $250,-

000, and it is expected to be in operation by November, 1903.

A survey for an electric line between the cities of Wilmington, Del., and Chester, Pa., is now nearly completed and the road for which it is being made will run parallel with the tracks of the Baltimore & Ohio Railroad. It is said that the new line will connect with the People's system in Chester. The capitalists who are financing the enterprise have refused to divulge their identity.

A new power house is soon to be built in Racine, Wis., by the Milwaukee Electric Railway and Light Company, whose present quarters are too small. It is expected that the building will be completed about December 1, and the Northwestern avenue line extended two miles further on. New cars have been placed on the line and many other improvements will be made before the year goes out.

Officials of the Toledo, Fremont & Norwalk, Ohio, Electric Railway have secured the right-of-way from Fremont to Oberlin for the extension of their line, which they expect soon to complete. This line, in connection with the Cleveland, Berea, Elyria & Oberlin Electric Railway, will furnish a continuous line from Toledo to the Forest City and will be a strong competitor of the Lake Shore Railroad.

Naples, Italy, is soon to be only three hours from Rome by an electric railway, according to a project submitted to the master of public works for a line to run from the western part of Naples *via* Cancello, Mondragone, Terracina and Cisterna. The line will be 133 miles in length and will have but very few grades. Eight trains will be run and the service will be almost entirely for passengers.

Printed placards are now being carried in the cars of the Philadelphia & Chester Railway Company which contain the information that the new company, which succeeded the Prospect Street Railway Company, will soon equip the road with new cars and that facilities for rapid and convenient travel will be introduced as speedily as possible. The announcements are signed by Mr. Harrington, superintendent of the road.

Estimates which call for an expenditure of about $20,000 have been made for the new power house of the Haverhill & Southern New Hampshire Street Railway Company, at Salem, N. H. The contracts have not as yet been awarded, but it is expected that the power house will be ready for use before the end of the Winter, provided, of course, no unusual delay is experienced in getting out the contracts or erecting the building.

The Hamilton County (Cincinnati) commissioners have granted a franchise to the Cincinnati Street Railway Company at the request of numerous petitioners of Price Hill suburb, for the extension of the Warsaw avenue line, in that city, to connect with the Elberon avenue line, thus forming a long belt line. The franchise was granted for a term of 46 years and is made coextensive with the grant made to the company under the Rogers franchise law.

Eastern capitalists are reported to have organized for the purpose of connecting St. Joseph and Kansas City, Mo., by a new electric railroad. The road as planned will be along the east bank of the Missouri River, touching Platte City, Parkville, Dearborn, Faucett and other small intermediate towns. The construction of the line and its ultimate fate depends entirely upon the completion of the Winner bridge, which is needed to obtain entrance to Kansas City.

An unconfirmed report of considerable interest states that negotiations are under way by the Metropolitan Street Railway Company, of New York, for the leasing of the Manhattan Railway Company. Both roads are soon to be operated by electricity and it is believed that the Metropolitan, if it secures the Manhattan, will guarantee at least a five per cent dividend on the latter's stock to correspond with the increased earnings of the road under electrical operation. At the present time Manhattan stock pays four per cent.

An English paper states that the recent boom in the engineering trade threatens serious inconvenience and delay to the substitution of electric cars for the horse service in Manchester. At a recent meeting of the tramways committee it was stated that probably neither one of the two generating stations is likely to be ready to supply current when the tramways committee requires it for the new cars. The delay is supposed to be due to the difficulty which has occurred in getting the various contractors to finish the engineering work in time.

Residents of Bay Ridge and Fort Hamilton, N. Y., are again complaining of the poor service given them by the electric cars, stating that during the night passengers are frequently compelled to wait 15 minutes for the arrival of trolley cars which very seldom make the connections claimed with the Brooklyn Elevated. At times, in order to transfer from the street cars, one is compelled to walk a block or more to reach a car which is bound for the bridge. It is stated that the citizens in Fort Hamilton as well as the residents of Bay Ridge are protesting against this state of affairs.

A new electric road has been incorporated to operate between Los Angeles, Cal., and Salt Lake City, Utah, by Senator W. A. Clark and his associates. The capital stock of the company has been placed at $25,000,000, $6,000,000 of which has been paid up. When complete the road will be 1,100 miles long and will absorb the Los Angeles terminal road, which is 51 miles in length, with all its property and franchises, including 4,000 acres of land and all the wharfage in San Pedro Harbor, about 20 miles in length. This road will be taken over by the new company at a valuation of about $5,000,000.

A rear-end collision and wreck occurred recently on the Northwestern Electric Elevated Road, of Chicago, Ill., injuring five people so badly that they had to be taken to the hospital. The cause of the collision, according to the motorman of the second train, was that the curve in the tracks at the point where the accident occurred, the Chicago avenue station, was so sharp that he could not see the train ahead of him. As soon as he saw the danger ahead the brakes were put on but the momentum of the train was so great that the accident could not be avoided. An official of the road said that the affair was entirely accidental and that when the trains are rounding the curve at Chicago avenue the motorman is unable to see if his way is clear until the curve is passed.

Street railway consolidation in Worcester, Mass., has at last been realized and seven railways, with 140 miles of track and a capital stock of something over $2,000,000, will be operated by the Worcester-Boston syndicate under a new corporation, the New Jersey charter having been repudiated and a new charter obtained under Massachusetts laws. The seven roads named carried about 22,000,000 passengers last year and are valued at $4,500,000, their gross earnings amounting annually to about $1,085,000. A greatly extended transfer system will be adopted, lower fares to the suburbs will be inaugurated, new cars and improved rolling stock purchased, new routes of travel adopted and the entire system made thoroughly modern and up to date. Among the directors of the road are Messrs. Salisbury, Dewey, T. J. Coolidge, Jr., Oliver Ames and Samuel Carr.

Telephone and Telegraph

The Mississippi Valley Telephone Company's plant, in Minneapolis, Minn., was sold on Monday to satisfy claims already filed amounting to about $45,000. This plant is part of the independent system.

Among recent incorporations in the industrial field are those of the Rock County Farmers' Telephone Company, with a capital of $10,000, at Madison, Wis., and the New Washington Telephone Company, of New Washington, Ohio, with a capital of $5,000.

Contracts are soon to be awarded by the Central District and Printing Telegraph Company for the building of a new telephone exchange on Fourth avenue, in Pittsburgh, Pa. Plans have been prepared by local architects and the building contract will call for structures ten and eight stories high, both being steel framed.

A franchise has been granted by the common council of Little Falls, N. Y., to the Central New York Telephone Company, which was not entirely satisfactory to that company as the pole clause in the franchise stated that in the future, at the common council's discretion, the telephone company shall occupy union poles in common with other companies.

Mr. J. D. McLeod, general manager of the Wisconsin Telephone Company, in Milwaukee, states that when the company's list of subscribers reaches the number of 10,000, active operations will be commenced on building the Grand Central exchange on its Fifth avenue property. The company expects in the near future to have 15,000 subscribers and believes that it is only a question of a few weeks when 10,000 will be enrolled.

The Farmers' Telephone Construction Company has been organized at Milwaukee, Wis. Its purpose is announced to be that of supplying farming communities with telephones at popular rates. The officers are George N. Wiswell, president; S. A. Wadhams, vice-president, and Henry G. Gall, secretary and treasurer. The company is now completing its plans and intends to begin the active work of building lines and installing telephones in the early Spring.

The city electrician of Chicago, Ill., has reported recently very satisfactory results obtained from the aluminum wire put up for the department of that city during 1899. He further states that 10 miles more of the same wire will be strung during the present year. In this same connection it is interesting to note that the Pennsylvania Railroad, possibly the most energetic of all our American steam railroads, has had a line of aluminum telegraph wire in service for two years past.

Extensive improvements to its service all through the South are being projected by the American Telephone and Telegraph Company. Petersburg, Va., will soon be connected direct with Raleigh, N. C.; Savannah, Ga., with Augusta, Macon, Columbus and other cities in the state with which it now has no regular communication. Another line is to connect New Orleans, La., with Montgomery, Ala., *via* Mobile, and in Florida wires will be strung between Jacksonville and Ocola, while in Louisiana, the short line between Lafayette and Franklin will be projected to New Orleans on the southeast, and into Texas on the northwest, to Liberty and Houston, thus completing the line from Galveston to New Orleans.

Telephonic communication has been established in Norway between Christiania, Gottenburg, Malmo, and Copenhagen, in Denmark. The toll for conversation between the cities is at the rate of about 50 cents for a three-minute talk in the first district on Danish and Norwegian exchanges east of Porsgrund and south of Lillehammer, while for a longer distance 12½ cents are added for each district beyond the first. Conversations which use the line at a given time are charged for at three times the regular price and extra tolls of five cents are made when the party desired has to be called to the telephone. It is stated that the rates are not subject to special contract except in the case of government business.

Further tests under unfavorable circumstances of the Marconi wireless telegraph system were made on November 19 between Dover and the mail packet Princess Clementine. Prior to these tests the steamer's masts had been lengthened to 100 feet in the belief that the greater the distance of transmission the higher must be the receiver and transmitter. During the last experiments, however, a heavy wind was encountered which made the lowering of the topmast a necessity and it was expected that the long-distance communication would seriously be interfered with, but the operators were agreeably surprised when they found it was practically unaffected. A Dover message was received in the cabin of the Princess just as she was leaving Ostend, asking for particulars of the gale there.

A London, England, newspaper remarks that the telephone is no longer to be an expensive luxury in that city, as the new scale of charges will bring it within the reach of every one, so that in the course of a very short time the house without an instrument will be an exception. There will be alternative methods of getting the telephone installed, in the one case a lump sum will be paid annually for the inclusive use of the whole metropolitan system. This will no longer be £20, but a rental which, although it has not been fully determined, will not be greater than £10, and may be rather less. But probably the more popular way of subscribing will be on the "toll service." Under this method the subscriber pays a small initial sum—about £3—and then a penny per call for every time he rings up, and nothing, of course, when he is rung up. One effect of this method will be to make the majority of shops into public call offices, for the tradesman, paying a penny per call, will probably permit customers to use his instrument at, say, twopence per call, making it pay for itself possibly two or three times over during the year.

A remarkable telephone line is being operated in the State of Washington on the Pacific coast, nine miles of it being worked over a barbed wire fence, no insulators being used. In spite of this, the line does good work and the results are claimed to be satisfactory. The report containing this information states that considerable comment and lively interest are manifested among electricians in that state and that the results of operating a non-insulated line are almost as satisfactory as though it were set up and strung in the usual approved fashion. The cause of the line is the fact that several farmers, whose ranches are of large extent and whose houses are scattered, desire closer communication with each other; accordingly regular receivers and transmitters were procured. There was no necessity for the installation of an expensive pole line as barbed wire fences of the cattle-proof variety so common among stockmen were already built, the wire being nailed to the fence posts with staples, no insulation of any sort being employed. The receivers and transmitters were connected to the fence in the regulation manner and the line worked well. When roads had to be crossed, poles were set at the ends of the fences on either side of the road and the wire strung over them high enough to escape the tops of passing vehicles or hayloads. The line has had no breaks so far from grounded wires or other causes which it would seem at first sight impossible to control.

An Electrically Driven Direct-Coupled Jobbing Press.

In the illustration herewith is shown a jobbing press driven by a direct-connected electric motor. The press is a three-color pneumatic jobber capable of making 2,400 impressions per hour when operated at the fast speed, and 1,200 impressions per hour when operated at the slow speed. The difference in speeds is obtained by the controller that regulates the motor. This is of such a design that a great number of intermediate speeds may be obtained on the press, and, consequently, any number of impressions per hour may be made between the limits mentioned above. The motor is manufactured by the Triumph Electric Company, of Cincinnati, Ohio, and is of its standard direct-connected press type. The motor itself operates at 128 revolutions per minute at the high speed, and with the controller it can be cut down to 64 revolutions per minute. The frame of the motor is made of close-grained, soft cast-iron, with pole-pieces of the laminated type. Each lamination is specially treated before the pole-piece is put together, and cast-welded into the frame, whereby eddy currents are reduced.

The armature is of the iron-clad laminated core tooth type, and each disk is especially treated before mounting on the spider, to prevent losses. The commutator bars are of drop forged copper insulated from each other and the shell by the best quality of mica. The commutator shell is of cast steel, the back shell extending completely under the segment having a turned projection carrying the front shell. This prevents any oil that might leak along the shaft from getting underneath the segments, and also prevents the collection of dust or dirt. The coils of the armature are machine-wound, are interchangeable, and can be easily replaced in case of necessity. The field coils are also form-wound, and, like the armature coils, may be easily removed and replaced.

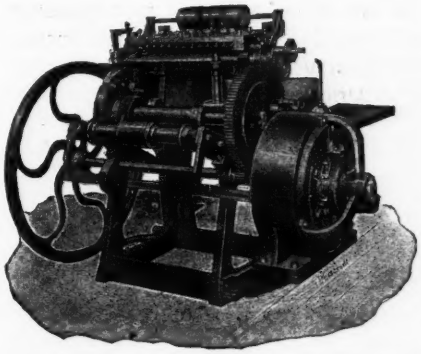
The outboard bearing is carried on the frame of the motor, and is of the self-oiling and self-aligning type. The entire motor is mounted on brackets that are bolted fast to the press, making a completely self-contained outfit. The Triumph Electric Company manufactures these motors in several sizes to operate at whatever speed is desired, according to the speed of the press or tool to which they may be direct-connected. The smaller sizes are of the six-pole construction, and the larger sizes have eight poles. The particular motor illustrated is a one horse-power six-pole machine, and the figures quoted above show that it runs at a very slow speed for such a small motor.

Electrical Goods in Calcutta.

United States Consul-General R. F. Patterson sends the following from Calcutta, India:

Electricity as a motive power has not been used in Calcutta; but the Calcutta Tramway Company, Limited, is now preparing to change its lines from horse-power to electricity, and the contract for the power station has been given to Messrs. Dick Kerr & Company, Limited, of London. The first shipments for the plant are expected to arrive here in December of this year.

I have answered many letters from our various electrical companies relative to the use of electricity here, calling their attention to the proposed change in the tramway company's lines, and believe that, with proper efforts on their part, the contract might have been secured, as American are now competing successfully with the English companies, even in London.



AN ELECTRICALLY DRIVEN DIRECT-COUPLED JOBBING PRESS.

Electricity is now beginning to be extensively used in Calcutta for various purposes, such as lighting, fans to take the place of punkhas that were pulled by coolies, for driving machinery, etc., and there is an opening here for the sale of electrical machinery and goods, which our manufacturers should take advantage of.

I would advise correspondence with Messrs. Kilburn & Company here, who have an electrical plant and are furnishing electricity and electrical machinery and goods; also, with the following-named firms in Calcutta, who are dealers in such machinery and goods, *viz* Osler & Company, Octavius Steel & Company, and the Calcutta General Electrical Company.

All machinery is now entered duty free in India, but there is a duty of five per cent ad valorem on goods.

There is a direct line of steamships between New York and Calcutta, but a cheaper freight on machinery and goods not required for immediate use would be by sailing vessels *via* the Cape.

Engine Builders' Association of the United States.

The Engine Builders' Association of the United States held its annual meeting at Sherry's in New York city, on December 4. At the afternoon session papers were read by President John E. Sweet, Mr. H. C. Ebert, of the Westinghouse Electric and Manufacturing Company, Mr. H. G. Reist, of the General Electric Company, and Mr. E. J. Armstrong, of the Ball Engine Company.

President Sweet in opening the meeting made a few prefatory remarks regarding the avoidance of useless competition among engine builders, and advocated strongly the combination of steam engine builders with electric generator manufacturers for standardizing purposes.

Mr. Ebert's paper was the first to be read, and was entitled "Interrelations Between Engine and Generator Builders, in Connection with Engine Type Units for Power Purposes." The paper dealt in a thoroughly comprehensive manner with the difficulties besetting both electrical and steam engine manufacturers, advocating the adoption of some definite rules to make standard units possible. After the paper was read, the subject was opened for discussion, and for nearly an hour remarks were made and questions asked by both members and guests, to all of which Mr. Ebert replied in a thoroughly clear and satisfactory manner.

Mr. Reist, of the General Electric Company, read a paper entitled "Some of the Requisites of Modern Lighting Generator Sets." This was received with applause, and a discussion followed, after which Mr. Armstrong's paper on the "Economy Guarantees of High Speed Simple Engines" was presented. Mr. Armstrong is a firm believer in the single-valve type of engine, and defends his theories by his paper, and also with several carefully executed drawings of tests which had been made at the Ames Iron Works with Ames engines, showing an economy of the single-valve simple engine over the four-valve, ranging, in many cases, from 25 per cent above to 25 per cent below normal load with only an extra pound of water consumed.

At the conclusion of the meeting a vote of thanks was passed for the papers presented, and Mr. T. C. Wood, of the Ball & Wood Company, on behalf of the association, extended a cordial invitation to the friends and guests of the organization who were present to attend the banquet given in the restaurant at seven o'clock in the evening.

It was decided unanimously that the papers presented should be compiled and printed for distribution.

These officers were reelected for the ensuing year: President, Professor John E. Sweet; vice-president, W. M. Taylor; treasurer, H. L. Ide; secretary, S. F. Bagg.

A New Telegraph System for Puerto Rico.

General A. W. Greeley, chief signal officer, United States Army, in a recent report sent to the committee on Pacific Islands and Puerto Rico, thoroughly discussed the matter of telephone and telegraph service in the island, and with this report as a basis Congress will be asked, at its next session, to take definite action to improve the service.

In his report General Greeley briefly outlines the history of both the industries on the island, beginning with the installation of a short telegraph line in 1872. The first steps in the matter were taken in 1860, but it was not until 12 years later that the city of San Juan was actually connected with the seven different departments of the island, requiring altogether about 800 miles of wire. These were the wires which were found on the island when our troops compelled the Spaniards to evacuate and the places of the Spanish operators were filled with signal corps men, who are still operating the lines without other pay than their regular stipend from the government. Even with this method, however, the service is very expensive, owing to the small amount of commercial business and the expense connected with replacing wires damaged or blown down by heavy winds. The normal receipts of the line, when under military control, will amount to about $12,000 a year for the present and possibly next year, which will increase within the next five years to about $18,000 annually, an amount inadequate for the maintenance and operation of the line by civilians.

The report continues to point out three courses which are open for their maintenance: 1. For the ultimate disposal of the lines; namely, their operation by the United States Post Office after the Spanish method; 2. The transfer of all the lines to the insular government with a view to their operation and maintenance at the expense of Puerto Rico; and last, their continuance as military telegraph lines.

General Greeley points out that the first scheme would demand a large outlay from the United States every year, as a new department would be required with a large personnel. This has nothing in its favor except the fact that the telegraphing would be a governmental function. The second plan would necessitate forcing a heavy burden of taxes upon the people of the island, who would not be benefited in a single instance, with the exception only of the old force of telegraph operators, which numbers about 180. For the third proposition General Greeley says: "The third plan seems to the chief signal officer of the army the easiest and most natural solution of the question. Puerto Rico must necessarily be fortified and garrisoned by troops of the regular army; and, as it is a detached island, liable in time of war to certain invasion, it is of the utmost military importance that the different garrisons should be in either telephonic or telegraphic communication, thus insuring the greatest possible military efficiency of the defending forces. If this suggestion is adopted, it may be added that for the execution of this plan no legislation is necessary, as the signal corps of the army is now charged with the operation and maintenance of these lines until action is had thereon by the Congress of the United States. The same policy would be followed with those military lines as elsewhere, namely, the gradual condemnation and sale of lines no longer necessary in the public interest and the maintenance of only those necessary for strictly military purposes."

A Disk Reflecting Shade.

The illustration herewith represents a

A Disk Reflecting Shade.

disk reflecting shade manufactured by the Kneeland Reflector Company, 223 Friend street, Boston, Mass. The shades are made in five sizes, and are finished in silver, green bronze or green enamel. The same company also manufactures half shades of aluminum, silvered glass and tin, as well as many types and shapes of holders.

The statement that the Metropolitan Street Railway Company, of New York city, is to assume control of the Brooklyn Rapid Transit is denied, yet there seems some basis for the report that two leading directors of the Manhattan have been placed on the board of the Rapid Transit Company. A director of the latter, when questioned, would not deny the change, and it is believed that Messrs. Ryan and Whitney, who are heavy holders of Rapid Transit stock (which would make them eligible for directorship), will be the men selected if the rumor is true. This is also denied, for both companies seem to fear that the city would compel them to carry passengers from one end of Greater New York to the other for one fare, which, of course, would be very unprofitable.

Corporation News

Nashville, Tenn.—The Bristol Light and Power Company, of Bristol, has been recently incorporated for $25,000 by local interests.

Dover, Del.—Among the recent incorporations in Dover is that of the Consolidated Safety Third Rail Electric Company, of New York. This company is capitalized at $100,000.

Indianapolis, Ind.—A new corporation of Linton, Ind., is the City Lighting Company, incorporated on November 8 with a capital stock of $10,000. The directors and promoters are all local men.

Trenton, N. J.—The Dynelectron Company has been incorporated, with a capital of $1,200,000 in common stock, to manufacture and deal in electrical supplies. Inventions which have been bought by the company will be handled as well as outside goods.

Camden, N. J.—Vice-Chancellor Reed, of Camden, granted an application for a receiver for the Cape May, Delaware Bay & Sewall's Point Railroad, the applicant being the New Jersey Trust and Safe Deposit Company, as trustee for the bondholders under a $150,000 mortgage.

Americus, Ga.—Application has been made by the Brunswick & Birmingham Railroad Company for a charter. The company proposes to construct a line from Brunswick, *via* Montgomery, to Birmingham, and will be capitalized at $6,750,000. It is stated that the road is regarded as a certainty.

Chicago, Ill.—A trust deed has been executed by the Western Electric Company to the Chicago Title and Trust Company upon 225,000 square feet of land at West Pope street and the river front in that city, to secure a bond issue of $500,000, payable in 1905, and bearing four and one-half per cent interest, payable at the Bank of New York.

Danville, Ill.—Charles F. Howorth, William Henderson, John Fletcher, all of this city, incorporated the Vermilion County Telephone Company, at Springfield, on November 16, with a capital stock of $60,000. The company will operate a telephone system in Danville or vicinity and expects to commence active operations in the near future.

Harrisburg, Pa.—Amos Hollinger, of Lancaster, Pa., is the moving power in the new Lancaster, Willow Street, Lampeter & Strasburg Railway Company, which has recently been incorporated with a capital stock of $150,000, to build a 10-mile electric line within the boundaries of Lancaster County. The new concern is said to have no connection at all with the Conestoga Electric Company or the Lancaster Railway Company.

Electric Lighting

The Kings County Light and Power Company has declared a quarterly dividend of one and one-half per cent, payable December 1.

Anglesmere, Pa., is soon to have a new electric light plant. The building will be of brick and iron, one story high, with concrete flooring. Williamsport capital is said to be behind the scheme.

A 50-year franchise has been granted by the city council of Arkadelphia, Ark., for the installation of an electric light plant. By the terms of the franchise work must be begun within 60 days.

Work is actively progressing in Seneca Falls, N. Y., on the foundation of the new 200-horse-power engine for the lighting system shortly to be installed. The expenditure is estimated at about $10,000 to $12,000.

The Shamokin & Coal Township Electric Company is soon to locate its plant in Shamokin, Pa., where three sites have been looked at and favorably reported. The company expects to be ready to furnish light and power within six months.

The Mount Gilead, Ohio, Water, Light, Heat and Power Company has been incorporated with a capital stock of $60,000. The company will furnish light, heat, water and power to the citizens, and will build a plant for its manufacture.

Red Lion, Pa., is soon to have its electric light plant rebuilt. The Red Lion Electric Light Company is the owner and the plant is the one which was recently destroyed by fire. Machinery of the most modern type will bring the new plant thoroughly up to date.

Conemaugh, Pa., is at present a very dark town, but in the near future thirty arc lights and a considerable number of incandescents will be placed in the streets, business houses and residences. The plant which will supply the current for this installation is said to be very complete although small.

A largely increased business is the cause of an increase of the capital of the Queens Borough Electric Light and Power Company to $410,000, noted in these columns in a previous issue. The increase in stock is to meet the expense of enlarging the company's plant at Far Rockaway, which will be practically a model of its sort when the improvements are finished.

Among recent appropriations from the board of estimate of Baltimore, Md., are $15,000 from the park fund for an experimental municipal lighting plant at the western pumping station. This amount was taken from the park fund and it is expected to cover also sufficient current for the 150 lights with which Druid Hill Park will be illuminated.

The Central Investment Company, of Milwaukee, Wis., has recently decided to construct and operate a private electric light plant for the use of tenants of the Chamber of Commerce and the Mitchell Building, both of which structures it owns. The company believes that money can be made out of the scheme and the quality of the service rendered better, if anything, than that given by the General company at even lower figures.

AN ENGLISH INCANDESCENT STREET LIGHTING FIXTURE.

An English Street Lighting Incandescent Fixture.

In lighting streets by means of incandescent lamps it has been the usual custom to replace the ordinary four-foot or six-foot gas burner by an incandescent lamp of 16 candle-power, and thus produce about as much light at about the same expense and with no betterment of the general illumination except that obtained by the greater steadiness of the incandescent lamp. The fixture illustrated in the accompanying engraving is one designed by a British concern for use with reflector-base lamps, in which the base part of the turnip-shaped bulb of the lamp is silvered. By this means the axial candle-power of the lamp is much enhanced and the arrangement shown is said to give a maximum of light in a horizontal direction where it is most required and a minimum for the illumination of the sky where the light is wasted. The design seems good and simple and one perhaps worth the consideration of American manufacturers.

Power Plant at the Charlestown, Mass., Navy Yard.

Construction work on the new temporary power plant at the United States navy yard, at Charlestown, Mass., is being rushed as fast as possible and the foundations for the temporary wooden building, which is soon to be erected at the western end of the site of the big central power station which will be built next year, are well under way. Part of the foundations of the wall will be constructed of very solid masonry, as the permanent building will rest on them when the temporary structure has been torn down. In order to secure the necessary space for the temporary wooden building a portion of the shipfitters' mill was torn down.

The new plant, which will be erected entirely by the navy yard workmen, will consist of boilers and generating machinery for electric and pneumatic plants, which will be used in connection with the department of construction and repair. Four boilers will be employed in batteries of two each, giving a maximum of 1,200 horse-power. The boiler frames have been already set up on permanent, solid foundations and the 150-foot smokestack is progressing well. Babcock & Wilcox, the Elizabethport, N. J., water-tube boiler manufacturers, have the contract for both the boilers and smokestack, the estimates amounting to $21,000.

Separated from the boiler and engine room by a heavy fireproof brick wall is the dynamo room, which is being equipped by the Westinghouse Electric and Manufacturing Company at a cost of $59,000. Three dynamos will generate 1,050 horse-power. The pneumatic apparatus will be supplied by a New York firm for about $15,000 and will include two 500-foot capacity air compressors, one hydraulic accumulator of 1,000 pounds pressure, condensers, feed water heaters and pumps. The big central power station, which is to be of brick and iron, 450 feet long by 110 feet wide, will take in the temporary station which is now being built and which is expected to be finished by October 1, 1901.

Industrial Notes

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, is reported to have taken an order in New York city last week for $175,000 worth of arc-light carbons.

THE DAYTON ELECTRICAL MANUFACTURING COMPANY, Dayton, Ohio, is just placing on the market a newly designed igniting dynamo with starter equipment.

A. L. IDE & SONS, Springfield, Ill., have issued a bulletin describing and illustrating in detail the "Ideal" engine governors made under the patents of F. M. Rites and others.

THE BALDWIN TELEPHONE COMPANY, Baldwin, Wis., is installing automatic telephones manufactured by the National Automatic Telephone Company, of Chicago.

THE ASHEVILLE MICA COMPANY, Asheville, N. C., announces that it has found a new mica bed containing mica which, it says, is as soft as the Canadian amber mica.

THE AMERICAN BRIDGE COMPANY is furnishing, from its East Berlin, Ct., plant, the steel work for power station No. 3, for the Hartford Electric Light Company, at Hartford, Ct.

THE LEA ELECTRIC MANUFACTURING COMPANY, of Elwood, Ind., has every reason to be pleased with the demand for its arc lamps. The factory is now running day and night in an endeavor to keep up with its orders.

THE NEW YORK & OHIO COMPANY, Warren, Ohio, has issued a large lithograph of its famous "Tommy," the purpose of the picture being to advertise the Packard incandescent lamps and transformers, which it makes.

THE MILWAUKEE ELECTRIC COMPANY, Milwaukee, Wis., will, in the near future, equip a new factory which will employ from 400 to 500 men, at an approximate cost of $25,000. This company manufactures dynamos and motors.

THE ELECTRIC APPLIANCE COMPANY, Chicago, makes the claim that the Adams-Bagnall is the only arc lamp made especially to work on street railway circuits. It burns five in series on 500 volts, each lamp working independently of any other.

THE LANE & BODLEY COMPANY, Cincinnati, Ohio, is sending out folders of its modern Corliss engine, accompanied by an engraving of its double eccentric valve gear Columbian Corliss engine, with double port opening valves and elevated dash pots.

THE AUTOMOBILE AND SUPPLY COMPANY, of Twenty-third and St. Charles streets, St. Louis, Mo., has completed a gasoline trap to go to Sierra Hermousa, Mexico. It is an elegant vehicle, powerful and fast, and will carry four passengers and baggage and make a run of 150 miles.

J. H. BUNNELL & COMPANY, 20 Park place, New York, has issued a Manual of Telegraphy of some 32 pages, illustrating the uses of the telegraph instrument and giving a concise set of instructions for setting it up. Abbreviations and forms of messages are also given, making the little book complete.

AUGUST MIETZ, 87 Elizabeth street, New York, has issued a neatly illustrated pamphlet, advertising the advantages of the Mietz & Weiss gas engines, well pumps and deep-well pumping engines. The points claimed by the manufacturer are simplicity, economy, safety and capacity for work. The pamphlet will be mailed upon application.

H. M. SHAW & COMPANY has recently moved its factory from Rahway to Newark, N. J., in order to increase its manufacturing and shipping facilities. This company manufactures Shaw's non-arcing lightning arrester for alternating and direct-current circuits. The executive offices of the company are located at 115 Broadway, New York city.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, is just introducing the new "Dinkey" ventilated controller, which is equipped with a magnetic blow-out that is claimed to prevent arcing and to increase the life of the brushes of the segments at least fourfold; also it is claimed to preclude the possibility of the brushes sticking to the segments.

THE WESTERN ELECTRIC COMPANY'S new fixture catalogue contains reproductions of the various styles and designs of thoroughly first-class goods. Not only are plain and ornamental fixtures for residences displayed but those for offices, factories and stores as well. The needs of office men, doctors, dentists and artisans have been considered in the line of specialties. A copy will be sent on request.

THE CARE TAKEN in the construction of the Crown woven wire brush has made this brush popular all through the entire electrical field. The brush is closely wrapped and prevents, to a great degree, the sparking which is customary with many brushes. The company also announces a large sale of its Crown commutator compound, which is used in preserving the commutator of a dynamo or motor.

THE COLLIERY ENGINEER COMPANY, Scranton, Pa., has issued its current number of *Science and Industry*, devoted to the interests of the students of the International Correspondence Schools and all those interested in electrical, mechanical, civil and steam engineering. The magazine contains articles ranging from descriptions of revolving storms to oil in steam boilers and the construction of a sheet metal cupola.

THE COLUMBIA ELECTRIC SUPPLY COMPANY, 93 Liberty street, and 329 Fourth avenue, New York city, has recently greatly enlarged its facilities and increased its stock and is now better equipped than ever in its history to take care of its growing electrical trade. Both the Liberty street and Fourth avenue stores carry very extensive stocks and these will constantly be added to. They are excellently located for the growing business they are receiving.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., manufactures special types of Columbia lamps for series burning on street railway circuits. These lamps are guaranteed by the manufacturer to be absolutely uniform in current consumption, thereby giving a uniform distribution of light. The filament is unanchored, having a two and one-half turn coil, which gives it stability and also prevents breakage by vibration. These lamps are made full size.

THE BOOKER CARBON AND BATTERY COMPANY, 2134 De Kalb street, St. Louis, informs the ELECTRICAL REVIEW that its entire plant has been remodeled and rebuilt with the best and most modern machinery. Within a week the company will be in a position to fill orders promptly for any thing in the carbon or battery line. Colonel S. G. Booker is the moving spirit of the company, and his well-known ability as a carbon manufacturer should assure the company's patrons of the highest class of product in this line. Colonel Booker intends to visit the east shortly, to renew his many acquaintances in the electrical field.

THE ELECTRIC GAS LIGHTING COMPANY, of 195 Devonshire street, Boston, Mass., is placing on the market a new concealed automatic candle burner. The mechanism of this new automatic burner is very simple, consisting of two iron-clad magnets placed one above the other, between which is located a gas valve. Through an extension of the valve a pin is driven, one end acted upon by the upper armature to open the valve and ignite the burner, and the other end by the lower armature, which serves to close the valve and extinguish the flame. When connected, the burner has a very neat appearance, and can be lighted at will by simply pushing a switch.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., has recently issued its bulletin No. 3,025, describing a low-priced, alternating-current motor, in sizes from one-tenth to one-sixth actual horse-power. This type of motor is made with one-half inch shaft, and is said to be suitable for severe and continuous operation, being a more durable motor than the types usually placed on the market of similar capacity. A copy of bulletin No. 3,025 will be sent free to any address on request, and a sample of this new type of motor will be forwarded to any responsible electrical dealer or central station interested in placing this form of apparatus in operation.

THE MICHIGAN TELEPHONE COMPANY, Detroit, is preparing to enlarge its manufacturing plant for the production of telephone apparatus. For some time past the company has been making instruments in a small way, but now intends to equip a plant which will enable it to turn out everything in use in its system, from complete switchboards to the smallest repair parts. Heretofore such apparatus had to be purchased from the regular manufacturer. The new shops will open on or about January 1, employing at the start 200 men. This number will be increased from time to time as the requirements of the service make necessary. In this same connection, the Erie system, of which the Michigan Company is a part, will operate a similar factory in Pennsylvania, probably at Scranton.

THE CHICAGO & ALTON RAILWAY has lately added to its fast through service several trains in which are embodied electrical appliances of the most modern type. All the new high-speed passenger locomotives of the Alton are provided with dynamos which supply current to the headlights, incandescent signal lamps, automatic oiling apparatus, and to the lamps and call bells throughout the entire length of the train. Mr. B. L. McLain, general eastern passenger agent of the road, says that "The Electric Limited" would be a good name for any of the Alton's fast-lines, and ends his statement by saying that each train has electric search-headlights, electric signal lamps, electric lights for oiling, watering and feeding the locomotive, electric reading lamps, electric centre lamps, electric call bells, electrified passengers.

THE EUREKA ELECTRIC COMPANY, Chicago, is manufacturing what it calls the Eureka "Three-Way Jack." By the aid of this device it is said to be possible to use a toll line for as many conversations as there may be "lock-out service" on the line where the device is installed. A good many companies, after going to the expense of building expensive lines, find it impossible to give service for more than one conversation at a time over the line with the old method, but by the use of this Eureka "Three-Way Jack" and "lock-out service" it is possible to utilize as many different portions of the line for as many conversations as may be desired, so long as no two conversations overlap each other. This device is fully described in the Eureka company's new "20th Century" catalogue, and any further description and blue prints the company will be pleased to furnish to any exchange or toll line that may be interested.